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Cover photo: The photo shows a wolf spider (Araneae: Lycosidae) from Grand Sable Dunes on the shore of Lake Superior, Pictured Rocks National Lakeshore, Alger County, Michigan. Spiders in this family are more commonly observed on the ground surface rather than in vegetation. Without examining the spider under the microscope, it is not possible to do more than guess about the specific identity of this animal. This illustrates one reason why the acquisition of data on this ubiquitous group of animals has been a slow process. See related paper on page 111. Photo by Gary Fewless (University of Wisconsin–Green Bay).

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PALAEOECOLOGICAL INTERPRETATION OF POLLEN, MACROFOSSILS, POLYGONAL FISSURES, AND TAPHONOMY OF THE SHAFER MASTODONT LOCALITY, WARREN COUNTY, INDIANA

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ABSTRACT. Discovery of the jaw of an American mastodont (*Mammut americanum*) and an unusual sedimentary profile in a cornfield in Warren County, Indiana, prompted a multidisciplinary study of the palaeoenvironment of the site. Wood taken from near the base of the deposit was dated at 15,540 ybp. Stratigraphic and textural analyses of the 2.3 m sedimentary profile reveal a series of inundation and desiccation events marked by polygonal fissures. Analysis of pollen from the sediment profile indicates that a boreal flora predominated during much of the time period represented by the profile. Pollen correlation indicates that the sedimentary record was truncated by unconformities around 10,000 ybp. Macrofossil analysis indicates a local environment that began as a forest dominated by white spruce and tamarack. Later inundation of the forest was indicated by the appearance of fish (*Perca flavescens*), meadow voles (*Microtus pennsylvanicus*), and submergent aquatic macrophytes (*Myriopyllum exalbescens*, *Potamogeton pusillus*, *Ceratophyllum demersum*, and *Najas flexilis*). The aquatic environment was interrupted by periods of exposure and desiccation as indicated by the disappearance of identifiable macrofossils and by the stratigraphy. The Shafer fossil assemblage is compared with other localities, and the taphonomy and palaeoenvironment of the mastodont are discussed.

Keywords: Mastodon, polygonal fissures, paleoecology, macrofossils, pollen, Late-Pleistocene, Holocene, Quaternary biota

On 5 July 1992, while digging a trench for drainage tile in his Warren County cornfield, Larry Shafer encountered teeth and jawbone fragments of the American mastodont (*Mammut americanum*). Upon discovery of the remains, digging was suspended; and Shafer contacted Purdue University archaeologists, who referred him to the Indiana State Museum. A thorough excavation of the site (referred to as the Shafer Mastodont Locality) was then conducted by staff and volunteers of the Indiana State Museum from 17–25 September in an attempt to recover additional remains of the mastodont and other associated fossil material. Little additional mastodont or other vertebrate material was recovered. However, the complex stratigraphy encountered at the site, including well-preserved fissure fillings and a lower stratum rich in plant macrofossils, provided an opportunity to characterize the paleoenvironment of the Shafer Mastodont. The discovery contributes to palaeoecological understanding of late-glacial and post-glacial environments in Indiana. The objectives of the present paper are to 1) document the fossil biota of the Shafer Mastodont Locality, 2) describe and discuss the taphonomy of the Shafer Mastodont, 3) determine the origin of polygonal fissure fillings at the

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site, and 4) reconstruct the palaeoenvironment of the area using pollen, macrofossils, vertebrate remains, and stratigraphy.

STUDY AREA

The study area is in Section 7, T23N, R6W, Chatterton Quadrangle, Warren County, Indiana (40°27′21″N; 87°07′52″W) at an elevation of 210 m (~690 ft. asl). It occurs within shallow, marginal wetlands associated with Otterbein Bog, a glacial kettle depression with a maximum depth of approximately 13 m (Richards 1938). The site is situated on a portion of the Crawfordsville End Moraine, part of the Cartersburg Till Member of the Trafalgar Formation, created approximately 16,000 ybp (years before present) during Wisconsin-age glaciation (Wayne & Zumberge 1965; Fullerton 1986). The peat in nearby Otterbein Bog originated from grass and sedge remains, and Richards (1938) reports that much of the recent vegetation of the wetland is *Phragmites* and *Calamagrostis*. The wetland surrounding Otterbein Bog is referred to on the United States Geological Survey (USGS) topographic map as "Cranberry Marsh," suggesting that the wetland may have harbored cranberry (*Vaccinium* cf. *V. macrocarpon*), a plant usually restricted to peatlands with a boreal climate or similar microclimate. The peatland is best described as a fen or sedge-meadow because it is not dominated by *Sphagnum* mosses and is extremely mineral-rich (as indicated by the predominant flora). The soils immediately around the site are mainly poorly-drained silty loams and silty clay loams of the Brenton, Drummer, and Williamstown-Rainsville series (Barnes 1990). The Shafer Mastodont Locality is situated on the southwest edge of Cranberry Marsh that formed within a kettle depression (Fig. 1).

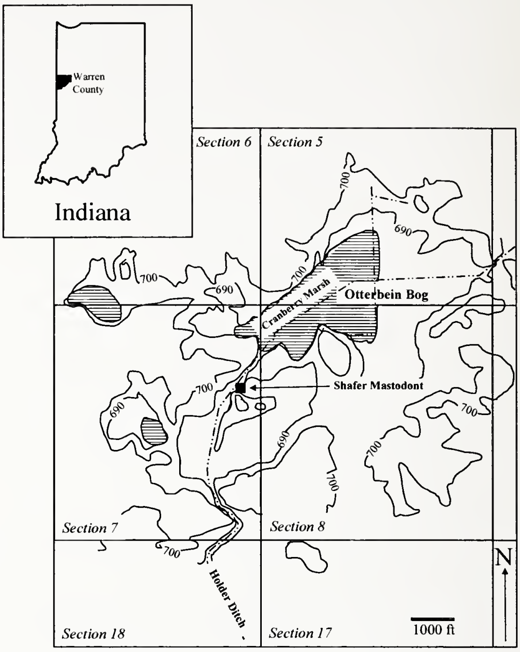


Figure 1.—Map of Otterbein Bog watershed (Sections 5, 6, 7, 8, 17 & 18, T23N, R6W, Warren County, Indiana), showing the location of the study area. Contour interval is 10 ft.(3 m) a.s.l.

METHODS

Field procedures.—Only a few fragments of mastodont bone at the Shafer Locality were found *in situ*; the remainder was disturbed by excavating. Disturbed soils were removed by shovel and trowel down to undisturbed soil. Thereafter, two intersecting trenches were excavated by shovel and backhoe near the location of the original bone fragments in an attempt to locate additional mastodont remains. Neither the 9.5 m long east-west trench nor the 10.2 m long north-south cross trench encountered any additional bone. Gasoline-powered pumps removed water that seeped into the excavation site, and also pumped clean water from adjacent Holder Ditch to wash excavated sediments for the recovery of microfauna and plant macrofossils. A site datum and baseline were established for leveling and mapping. Profiles and floor "bench" areas were created to facilitate mapping and photography of the complex stratigraphy. Bulk material from the trenches was variably washed through 1.2 mm (0.05 in) or 6.3 mm (0.25 in) mesh screens. When bulk screening from both trenches failed to yield any mastodont or other discernible biotic remains, the excavation strategy changed toward developing stratigraphic profiles, down to till if possible, to understand the geologic context of the mastodont jaw. In doing this, an organic silt, rich in conifer cones, was encountered. The soils from this "cone zone" were extensively sampled and washed through 1.2 mm mesh screen. Bulk soil samples were taken from each of the distinct strata in the profile for textural analysis and recovery of macrofossils. Additionally, small plastic canisters were driven into a freshly exposed profile at 10 cm intervals from the surface of the profile to the underlying glacial diamicton. These were capped and taken to the laboratory for pollen analysis.

During the excavation of a drainage pit at the south end of the north-south trench, the backhoe encountered a deeply-buried conifer log. This prompted eight exploratory pits and trenches several meters beyond the site perimeter. None produced any additional vertebrate material. A final widening and deepening of all the trenches and pits around the site still failed to yield bone of any kind.

Stratigraphic analysis.—Analysis of soil texture was accomplished using the Bouyoucos Procedure (Bouyoucos 1936). Percent organic carbon in the soils was determined using the loss-on-ignition method (Storer 1984).

Pollen analysis.—Extraction of pollen and spores from the sediment samples was accomplished using standard methods modified from Faegri & Iverson (1975). A 1 cm^3 sample from each level was used in processing. Palynomorph identification was based primarily on the key by MacAndrews et al. (1973), along with the aid of the pollen reference collection at the Center for Quaternary Studies at the University of Tennessee, Knoxville. Taxonomy follows Gleason & Cronquist (1963). Identification of black spruce (*Picea mariana*) and white spruce (*Picea glauca*) pollen was based on the morphometrics developed by Birks & Peglar (1980). Twenty spruce grains were measured for each level and assigned to either black spruce, white spruce, or undifferentiated spruce, following Hansen & Engstron (1985). These values were then used to assign the remaining spruce pollen to one of those categories. For each level a minimum of 300 terrestrial pollen grains was counted. Due to the existence of only a single radiocarbon date, it was not possible to calculate pollen influx rates for the profile.

Interpretation of the pollen diagram along with assignment of chronology was augmented by comparison with several studies, cited herein, which place the Shafer Mastodont Locality in a regional context. The pollen tally data are on file at the Center for Quaternary Studies, University of Tennessee, Knoxville, Tennessee 37996. Duplicate slides for each level are held by the Indiana State Museum (INSM).

Macrofossil analysis.—In addition to analysis of macrofossils obtained from bulk screening in the field using 1.2 mm (0.05 in) or 6.3 mm (0.25 in) mesh sieves, more careful analysis of the sediment was conducted in the laboratory to locate smaller or more delicate material. Subsamples of 300 cm^3 were carefully broken by hand and inspected for leaf impressions. To dissociate the soil, samples were then soaked in a 50 g per l solution of sodium phosphate for three days and rinsed through a 0.4 mm sieve. Macrofossils were identified and counted with the aid of a dissecting microscope. Excess bulk material that was not used in the quantitative subsampling was placed in a white enamel pan for recovery of large or infrequent macrofossils. Voucher specimens of macrofossils were deposited at INSM.

Radiocarbon dating.—A single radiocarbon date was obtained from a piece of spruce wood located at a depth of 2.1 m ("cone zone"), approximately 1.8 m below the level from which the mastodont molars and jaw fragment were found and approximately 20 cm above the glacial till. The wood sample, sent to Beta Analytic, Inc., was processed for a standard radiocarbon age determination (Beta-62640). An attempt was made to date the mastodont, but mandible fragments failed to produce recognizable collagen for dating (Beta Analytic, pers. commun.).

RESULTS & DISCUSSION

Stratigraphy.—The Shafer Mastodont Locality, like most of the other lakes and bogs that have yielded mastodonts in Indiana, is a shallow deposit of aquatic sediments that was truncated early in the Holocene. In this case, the profile represents a time period of approximately 5000 years, beginning just after deglaciation nearly 16,000 ybp. Four major divisions of sediments were identified in Profile 4 and designated as A through D, oldest to youngest (Fig. 2). Division A has also been designated the "cone zone" (as well as Unit XI in Fig. 2). This unit consists of wood and plant remains in a matrix of silt loam. A piece of wood from this zone yielded a radiocarbon age of 15,540 ± 70 ^{14}C ybp (Beta-62640), which provides a minimum age for deglaciation of the site and a maximum age for all other sediments above. Division B consists of interbedded silt and clay that is gray at the

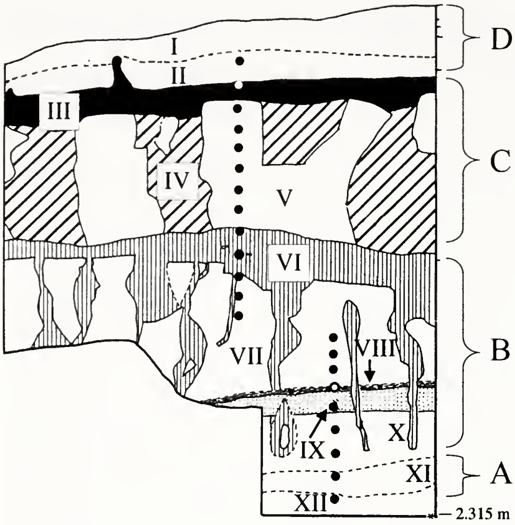


Figure 2.—Diagram of Profile 4, showing sediment divisions (capital letters) and units (Roman numerals). Dots represent the location of pollen samples taken from the profile at 10 cm intervals (see Table 1 for sedimentological details).

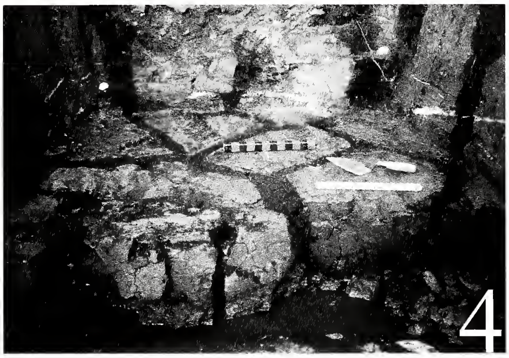
base (Unit X) then changes upward to blue-green (Unit IX), dark brown (Unit VIII), and brown (Unit VII) overlain by pure sand (Unit VI). This sand also in-fills fissures (Figs. 3, 5) that may extend downward into Unit X. Besides a thickness of up to 1 m of this sand as fissure in-fillings, there is another 5–25 cm as a blanket over younger units (Fig. 3). The unit both blankets the older deposits and fills the fissures within them. Sediments in Division C are similar to those below it and consist of brown silt (Unit V) that was buried, and fissures that were in-filled with brown silt loam (Unit IV) (Fig. 4). Unit IV of Division C is the source of the mastodont mandible. Division D consists of a cap of brown loam (Unit III), gray loam (Unit II), and black humus (Unit I). The oldest sediment reached in the excavation was late Wisconsinan till of the Wedron (?) Formation. This deposit of unknown thickness presumably underlines the entire basin of Otterbein Bog. It was not described at the Shafer Locality. Two samples were taken from below the cone zone, apparently from the matrix of till (Fig. 2), for laboratory analyses (Table 1, Fig. 2). The texture of these samples is silt loam. Loss-on-ignition averages 3.5%.

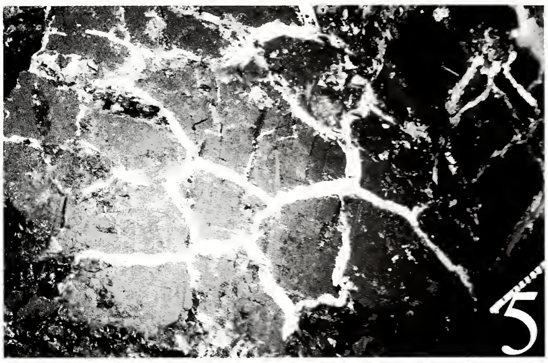
The sediments of the Shafer Locality are only about 2.3 m deep (Fig. 2), yet changes in the paleoenvironment are indicated by both the sediments themselves and the plant macrofossils and pollen they contain. The area appears to have been in a relatively shallow fringe zone, or shelf, around the margin of a much deeper kettle at the south end of the Shafer site. Back-hoeing well below the cone zone exposed clay and logs. Based on the topography of the area, it is likely that the Shafer Site was on a shelf, and erosion of the hillslopes (including sand and allochthonous organic matter such as wood, cones, and bones) may have transferred debris to the shelf. Waves and currents probably moved some of the debris to the deeper kettle.

As the landscape became less of a direct source of sediment for the kettle, sand percentages in the sediment declined from more than 10% in the cone zone (Unit XI) to only a few percent in the younger sediments (except for Unit VI). The size of the organic matter also declined, and the finer sizes characteristic of the younger sediments were more disseminated throughout the matrix rather than being concentrated as in the cone zone. The textures of Sediment Division B are silt loam, silty clay loam, and silty clay, textures common among glacio-lacustrine sediments. Mean organic carbon content was relatively low at 15%.

Delivery of organic sediments ceased temporarily during deposition of the sand of Unit VI. The extremely high percentage of sand in this unit (96%) and the fine to very fine sand size suggest eolian deposition during an episode of aridity. A backhoe pit dug north of the original excavation revealed a meter of massive sand and may be part of a sand dune. However, it is not known whether this eolian sand is the same age as Unit VI.

Organic deposition then resumed during the formation of the deposits of Sediment Division C. These younger sediments have about the same grain size, but have considerably more organic matter than those of Sediment Division B (Fig. 2, Table 1). Resumed deposition in a quiet-water lacustrine or wetland environment seems likely. The youngest sediments of Sediment Division D are probably the result of erosion in the drainage basin after European settlement. Sand percentages increase, but organic content is very high with a loss-on-ignition value of 50% in Unit III.





Figures 3–5.—Photographs of fissures encountered in sediment divisions B and C. 3. Profile; 4. Cross section of sediment division C; 5. Cross section of sediment division B.

Origin of the fissure in-fillings.—Three main hypotheses for the origin of the fissure in-filled polygons at the Shafer Locality were considered (periglacial, desiccation, and sand-blown mechanisms). Any reasonable hypotheses must include an explanation of two events: 1) what opened the vertically oriented fissures, and 2) how and when they were filled. Moreover, there is the possibility that the upper and lower sets of fissure in-fillings were formed by different mechanisms.

Criteria from several sources by which the periglacial, desiccation, and sand-blow mechanisms may be compared, both to each other and to the observations and data from the polygonal in-fillings at the Shafer Locality, are presented in Fig. 6.

Periglacial hypothesis: The primary sources of information about the periglacial origin of polygonal fissure-fillings used in the present study include Lachenbruch (1962), Bertouille (1974), Nissen (1985), Mears (1987), Nissen & Mears (1990), and Johnson (1990). The periglacial hypothesis requires temperatures cold enough to maintain permafrost. As the temperature drops, the permafrost-laden soil will crack. Meltwater will enter the crack and freeze, increasing the volume by 9%. Cracking may occur again and again, gradually building up an ice wedge. When the climate warms, the ice wedge melts, and sediment begins to fill the fissure. Most of the sediment is derived from the walls of the crack. Some small amount of material may be washed or blown in. The most critical condition for this hypothesis to be valid is temperatures cold enough to first form permafrost, then contract and crack it. The time of the

Table 1.—Field and laboratory data for Profile 4 at the Shafer Mastodont Locality, Warren County, Indiana. [1] SIL = Silt loam; SICL = Silty clay loam; CL = Clay loam. [2] NA = Not available.

Sediment division	Unit	Depth (cm)	% Sand	% Silt	% Clay	Soil texture[1]	% Org. C	Notes
D	I	0–15	NA[2]	NA	NA	Humus	NA	
D	II	15–30	NA	NA	NA	SIL	NA	Field texture
D	III	30–40	12	65	23	SIL	50	Overlies Units IV and V
C	IV	40–100	2	71	27	SICL	16	In-fills Unit V
C	V		23	47	29	CL	39	Grap sample near top
			12	58	30	SICL	21	7 samples, 10 cm apart
			7	59	34	SICL	18	
			9	61	29	SICL	20	
			6	60	34	SICL	19	
			1	64	35	SICL	14	
			2	55	43	SIC	17	
			9	49	42	SIC	13	
Mean (Unit V)			6.6	58.0	35.3	SICL	20.1	
B	VI	100–120	96	2	2	Sand	0.6	In-fills Units X-VII
B	VII	120–175	1	70	29	SICL	16	6 samples, 10 cm apart
			1	57	42	SIC	14	
			7	81	12	Silt	17	
			2	63	35	SICL	14	
			6	82	12	Silt	16	
			3	89	8	Silt	13	
Mean (Unit VII)			3.0	77.0	20.1		15.0	
B	VIII	175–180	1	97	2	Silt	10	
B	IX	180–185	1	68	31	SICL	7	
B	X	185–205	1	68	31	SICL	12	
			2	93	5	Silt	12	2 samples, 10 cm apart
A	XI	205–215	16	71	13	SIL	5	
			9	74	17	SIL	6	Sampled for ^{14}C dating
TILL		215+	6	79	15	SICL	4	Matrix of Late-Wisconsin till
			15	64	20	SIL	3	

Observation or Criterion	**Peri-glacial hypothesis**	**Seismic Sand-blow Hypothesis**	**Desiccation and In-filling Hypothesis**	***Shafer Mastodont Locality, Lower Set***	***Shafer Mastodont Locality, Upper Set***
1) In-fills occur as wedges, tapering with depth	Yes, active ice wedges taper with depth	Usually dike-like, with mushrooming if surface is reached. Usually widen with depth	Crack should propagate downward, thus be wider at the surface	*Almost all in-fills are wedges tapering with depth*	*Some in-fills taper with depth; many do not*
2) Map-view polygons	Yes, as shown by numerous active areas	Not likely, unless injection occurred along older fissures	Yes, widely known mudcracking is polygonal	*Well-defined polygons present*	*Well-defined polygons present*
3) Dimensions of polygons: a. Diamter b. Depth c. Thickness at junction with land surface	Diameters of 3 to 20 m, but mostly <1 m. Depths of 1 to 3 m. Thickness at the surface may average about 50 cm	No polygons. Depths of several meters. Thickness of < 1 cm to > 60 cm.	Very little data available.	*Diameters of about 30 cm, depth of about 1 m, thickness at land surface about 15 cm.*	*Diameters of about 75 cm, depth of about 90 cm, thickness at land surface about 30 cm*
4) Timing of in-filling vs. fissuring	If buried, ice wedges can melt slowly, perhaps over 2000 yrs. Sediments would replace ice as it melts	Sediment injected simultaneously with fissuring unless fissures formed previously by periglacial activity or desiccation.	With fissuring occurring during drying, cracks may develop very quickly and may remain open for many centuries.	*Formation of fissures estimated at 12,000 ^{14}C y BP, based on pollen assemblage.*	*Climate too warm to form periglacially. May have formed in last few decades after ditching.*
5) Temperature conditions	-6 to -8 deg. C	Any temperature.	Any temperature as long as drying can occur.	*Probably too warm to form periglacially after ~ 14,000 ^{14}C y BP*	*Definitely too warm to form periglacially.*
6) Composition of in-filled sediments vs. adjacent sediments	Similar to sediments surrounding the wedges; delivered by slumping from walls of fissure.	Sand-injected from below; host usually fine-grained	Almost always eolian silt or, more frequently, sand (few impurities)	*Nearly pure sand.*	*Organic sediments very similar to those adjacent.*
7) Presence of blanketing layer	Can be deposited once fissures are filled.	Only locally if surface is reached; mushrooming.	Can be deposited once fissures are filled	*Sand filling the fissures also blankets older sediments.*	*Sediment filling fissures does not blanket, but younger sediments do.*
8) Structure of in-fillings	Layering parallel to the wall and horizontal layering both possible, but may also be massive.	Usually massive, but may be vertical, stress-produced banding.	Probably rather massive, may locally be laminated.	*None noted.*	*None noted.*
9) Effects on adjacent material	Often deformed as ice takes up space.	None.	Cracking can cause deformation in host material.	*None noted.*	*None noted.*

Figure 6.—Observations and criteria of three hypotheses to explain the polygonal fissure fillings at the Shafer Mastodont Locality, Warren County, Indiana.

cracking is estimated at about 13,000 ^{14}C ybp based upon pollen correlation.

When the characteristics of periglacially-produced fissure in-fillings (i.e., ice-wedge casts) are compared with the observations and data at the Shafer Locality, there are both similarities and differences (Fig. 6). Periglacial in-fills are wedge-shaped; at the Shafer Locality, the lower fissure fills are, too, but some upper in-fills are tapered and some are not. Ice-wedge casts are usually polygonal; both upper and lower fissure fillings at the Shafer Locality are polygonal. The dimensions of the wedges and polygons are within the range expected for ice wedges.

Other differences between ice-wedges and the fissure in-fillings at the Shafer Locality include a very different sediment for lower in-fillings (pure sand) compared to the much finer surrounding materials, the lack of layering in the in-fillings at the Shafer Locality, and the lack of deformation in the adjacent materials. The periglacial origin for the upper set of fissure fillings at the Shafer Locality can likely be dismissed because the late Pleistocene and Holocene climate was much too warm to support permafrost. The possibility of a periglacial origin for the lower sequence remains. Such a case is supported by the wedge-shaped in-fills, their polygonal patterns, and range of dimensions for the in-fills, but these characteristics are not unique to periglacial mechanism. If the periglacial origin hypothesis is considered for the lower fissure fillings, then the permafrost would have to be present at a time after all the silt, sand, wood fragments, bone fragments, cones and other organic debris were washed into the lake; then organic sediment accumulated under boreal forest conditions for about three millennia (i.e., by about 13,000 ^{14}C ybp). By that time, it seems quite unlikely that permafrost was around in Indiana. Mean annual temperatures were probably warmer than −6° to −8° C.

Seismic sand-blow hypothesis: Primary sources of information about sand-blow phenomena used in the present study are Morris 1983, Gohn et al. (1984), Obermeiere (1987), Selley (1988), Munson et al. (1993), and Tuttle & Barstow (1996). Sandy sediments can be mobilized at the time of an earthquake through a liquification process. The sand is squeezed upward as a dike. The pressure will cause fissuring of older silty and clayey material as the sand is forcefully injected toward the land surface. If it reaches the surface, the injected materials will spread laterally for a short distance, forming a mushroom.

Although the seismic sand-blow hypothesis was considered as an origin for the fissure fillings at the Shafer Locality, it was noted immediately that seismic fissure in-fillings are not wedge-shaped and do not occur as polygons (Fig. 6). The seismic sand-blow origin can be considered only as part of a complex mechanism in which injection followed fissuring by one of the other mechanisms. Other aspects of seismic sand-blows that do not fit the Shafer Locality are the tendency of dikes to widen with depth, the apparent lack of a sand source with depth, and lack of structure in the fissure infillings. Some criteria for sand blows do match the conditions at the Shafer Locality. These include dimensions and lack of internal structure. Considering all the criteria for seismic sand-blows in Fig. 6, this mechanism is not likely the source for either set of in-fillings at the Shafer Locality.

Desiccation and in-filling hypothesis: The third hypothesis relies on drying and cracking, followed by in-filling with eolian sand at a later date. Primary sources of information about desiccation phenomena used in the study were Conybeare & Crook (1968), Calabresi & Burghignoli (1977), Haigh (1978), and Selley (1988). This hypothesis is not contradicted by any of the criteria in Fig. 6. Similarities between desiccation-caused in-fillings and both sets of fissure fillings at the Shafer Locality include the wedge shape, although this is more convincing in the case of the lower set. Similarly, both sets form polygons. We have found very little data on the size of desiccation polygons, but ordinary mud cracks are examples, and they seem to have dimensions that sometimes match those at the Shafer Locality.

The older set of fissures probably formed by 13,500 ^{14}C ybp (based on estimations derived from the pollen profile) as a result of desiccation. In-filling with eolian sand (Unit VI) must have followed quickly after fissuring because no other sediments are present in the fissures. The upper set of fissures may have formed by desiccation following ditching and lowering of the water tables in the early 1900's. Such fissures were filled with reworked organic sediment (Unit VI) before the site was blanketed with sediment resulting from cultivation of the surrounding landscape. Fissures of the upper set are still forming as witnessed by some fissures that were not filled with sediment. The fact that the upper fissures do not extend deeper is probably controlled by the level of the lowered water table.

All the observations and data at the Shafer Locality seem to be consistent with the conclusion that both sets of fissure fillings are the product of desiccation. Neither the periglacial hypothesis nor the seismic sand-blow hypothesis is a viable alternative to the desiccation hypothesis.

Both desiccation events (represented by Units V & VII) resulted in deep cracks (~80 cm) in the sediment. This suggests a nearly complete loss of the wetlands water source.

Because the entire profile represents a time when lobes of the Laurentide ice-sheet were still retreating from Indiana, it is possible that these successive water fluxes and desiccation events were driven by glacial meltwater dynamics. Beaver (*Castor canadensis*) may have also played a role. The oldest fissures (> 13,000 ybp) quickly filled with eolian sand. The sand, being fine and pure, likely originated from an area relatively devoid of vegetation, favoring erosion and transport by wind. Because macrofossils and pollen confirm a well-established forest community in the area, the sand must be from a relatively local source, perhaps redeposited from a beach/dune environment or a patch of land devegetated by fire. The decrease in spruce and the increase in ash correspond with the sand layer and the desiccation. The organic-rich silty clay loam that fills the youngest set of fissures may have been deposited during reinundation of the area (evidenced by the aquatic alga *Pediastrum*). It is at this time that the jaw of the Shafer Mastodont was washed into the cracks of Unit V.

Pollen analysis.—The pollen diagram along with the stratigraphy of the profile, vegetational zonation, and chronology is presented in Fig. 7 and is divided into three pollen zones (SML-1, 2, and 3).

SML-1 (210–85 cm): (15,540–ca. 13,000 ybp).—The deepest level in which pollen was found was 210 cm within the cone zone. Radiocarbon dating of wood from this level gave a date of 15,540 ± 70 ^{14}C ybp (Beta-62640). *Picea* (both black and white spruce) dominates the pollen record within this zone (> 80% arboreal pollen), with herb pollen making up between 5–10% (total pollen). Other conifer taxa include *Abies*, *Larix*, *Pinus*, *Tsuga*, and Cupressaceae (all less than 5%). *Quercus*, *Carya*, and *Fraxinus* occur in low quantities and were likely blown in from outside the local area. Other deciduous taxa that occur sporadically within this zone in trace amounts include *Ulmus*, *Ostrya-Carpinus*, *Betula*, *Salix*, *Juglans*, *Acer*, *Fagus*, *Platanus*, and *Populus*. The pollen from these taxa was likely blown in from outside the area. Herbaceous taxa are present at low levels (< 5%) throughout this zone. These taxa include *Ambrosia*-type, *Artemisia*, *Chenopodium*-type, Cyperaceae, and Poaceae. The upper-most portion of this zone exhibits a rise in herbaceous pollen (*Ambrosia* (ragweeds), Cyperaceae (sedges), Poaceae (grasses) from trace amounts to 5%. Aquatic taxa in this zone are limited to *Typha latifolia* (cattail) and *Pediastrum* colonies (aquatic algae). *Pediastrum* colonies were present in greatest abundance at the base of the profile, suggesting aquatic conditions early in the development of the soil profile. A gap in the pollen record occurs at 110 cm due to the sand layer (Unit VI) in which there was no pollen preserved.

SML-2 (85–45 cm): (ca. 13,000–11,000 ybp).—This zone is marked by the decline of *Picea* (from 80% to < 20%) and a rise in *Fraxinus* (from < 5% to > 40%). While it was not possible to identify *Fraxinus* to species at this site, it was probably almost entirely *Fraxinus nigra* (black ash) which grows in wet, poorly drained sites and has been identified at other locations in Indiana during this same period (Whitehead et al. 1982; Jackson et al. 1986). *Quercus* also increases to > 20% by the end of this zone. *Ostrya-Carpinus* pollen peaks at 17% in this zone and the profile for *Carya* becomes continuous. Other taxa with records that become continuous in this zone include *Ulmus*, *Betula*, *Salix*, *Juglans cinerea*, and *Acer*. Trace amounts of *Fagus*, *Celtis*, *Platanus*, *Populus*, and *Tilia* pollen also occur in this zone. Herbaceous pollen rises to > 20% in this zone, suggesting a closer proximity to, or expansion of, prairie vegetation to the west, or a more open woodland created by the dramatic decline in *Picea*. There are also small amounts (< 1%) of the aquatic taxa, *Nuphar*, *Sphagnum*, and *Typha latifolia*, suggesting the presence of aquatic vegetation, perhaps dispersed from nearby Otterbein Bog. The occurrence of *Pediastrum* colonies suggests at least periodic inundations with standing water. The sedge pollen could be an indication of a marsh environment during this time with cattails surrounding the edge of the site.

SML-3 (45–20 cm): (ca. 11,000–10,500 ybp).—The upper 25 cm is marked by a large increase in *Quercus* (from 20% to > 40%), *Carya* (from < 5% to > 20%), and *Ulmus* (from 6% to 20%), and a slight increase in *Picea* (from 10% to 20%) and *Pinus* (from < 2% to 7%). Additional temperate deciduous taxa that are present at low levels include *Betula*, *Juglans*, *Acer*, *Fagus*, *Celtis*, *Populus*, and *Tilia*. *Ambrosia* pollen rises to greater

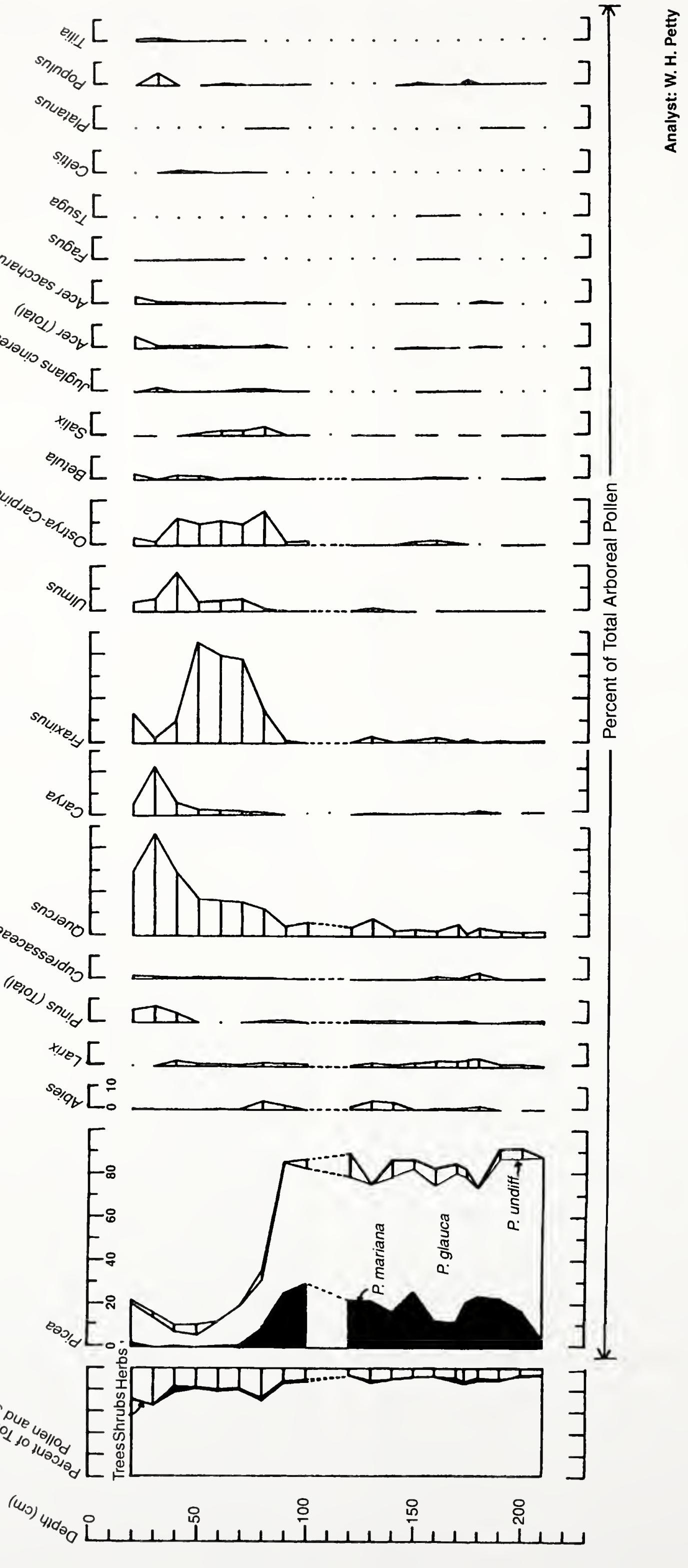


Figure 7.—Pollen diagram for the Shafer Mastodont Locality, Warren County, Indiana.

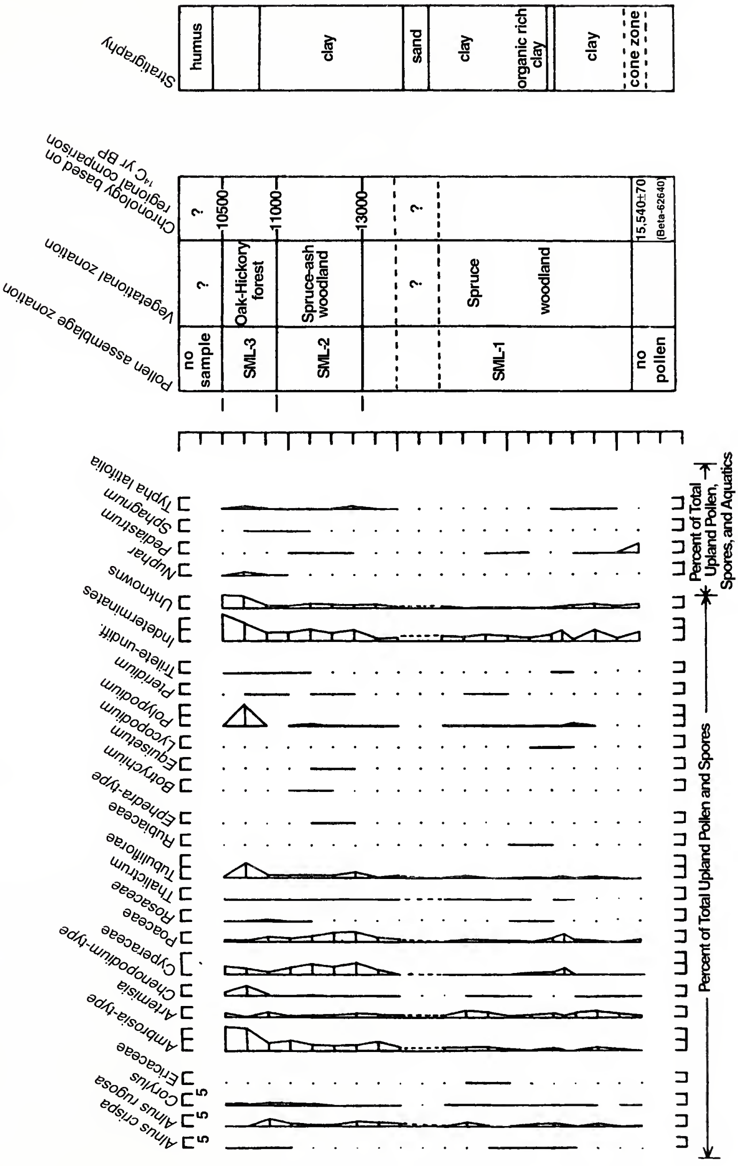


Figure 7.—Continued

than 10% within this zone, indicating that post-settlement pollen has been incorporated into this zone. Aquatics within this zone include *Nuphar*, *Sphagnum*, and *Typha latifolia*, all < 2%.

Macrofossil analysis.—Recognizable macrofossils were found in sediments between 150–230 cm below the surface, although they were relatively infrequent where found. The organic matter above this level was so highly decomposed that only minute, taxonomically indistinguishable plant remains were recovered.

The most distinct stratum in terms of macrofossil remains was a layer, at a depth of 200–230 cm (Div. A, Unit XI), that was characterized by numerous *Picea glauca* (white spruce) cones (Fig. 8). Radiocarbon dating of spruce wood from the unit revealed a date of 15,540 ± 70 ybp. A total of 0.36 m^3 of the cone-bearing stratum was washed through a 1.2 mm mesh screen in the field. Approximately 16% (by weight) of the strained material was wood fragments larger than 4 mm (mean oven dry weight of 3.7 grams dry organic weight per liter of sediment). The remaining 84% was small particulate material including wood, seeds, leaves, and other organic remains between 0.4–4.0 mm in size (mean oven dry weight of 22.4 g/l).

Eighty-six white spruce cones were recovered. In addition to cones, spruce leaves were also abundant, comprising 4–6% of the unstrained sediment. Large fragments of conifer wood, numerous conifer seeds, and bark were also recovered. *Larix laricina* (tamarack) was represented by spurs with leaf scars (Fig. 9) that numbered approximately 25 per liter of unstrained material. Seeds determined to be of the family Juncaceae, possibly *Luzula spicata*, were also present in similar numbers. The wetland moss *Drepanocladus aduncus* was found to have a mean density of 17 fragments per liter. Aquatic plants, *Potamogeton pusilus* (pondweed) (Figs. 10, 11) and *Najas flexilis* (bushy pondweed) (Fig. 12) were present, but extremely infrequent. Several head capsules, pronota, and elytra of coleopterans were also recovered.

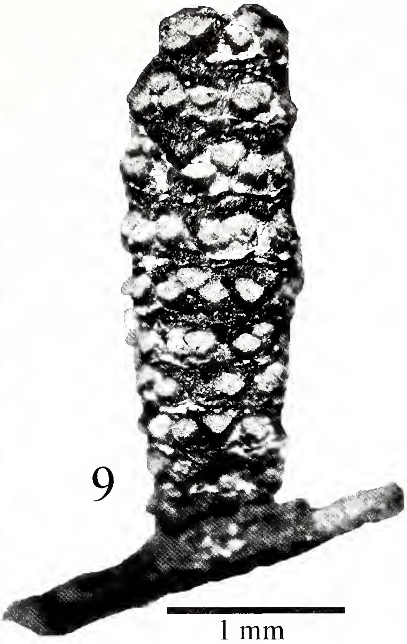
Unit X of Division B was marked by an increase in remains of aquatic macrophytes and a sharp decrease in conifer remains. *Myriophyllum exalbescens* (milfoil) leaves were found as carbonized imprints in the silt (Fig. 13), and as discrete fragments. The fragments comprised approximately 10% of the unstrained sediment. *Najas flexilis* achenes numbered 12 per liter. Both *Drepanocladus aduncus* and Juncaceae were absent from this stratum.

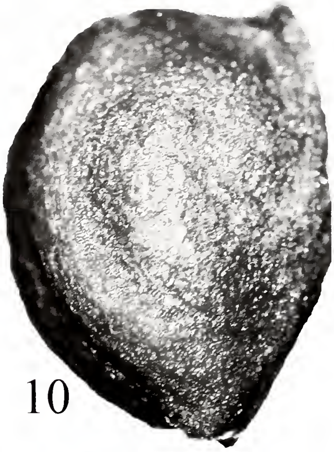
Unit IX of Division B marks the disappearance of conifer and other remains of terrestrial origin and the appearance of *Ceratophyllum demersum* (hornwort) leaves. *Myriophyllum exalbescens* remained in similar quantity. Identifiable macrofossils were essentially absent from most of Units I–VII.

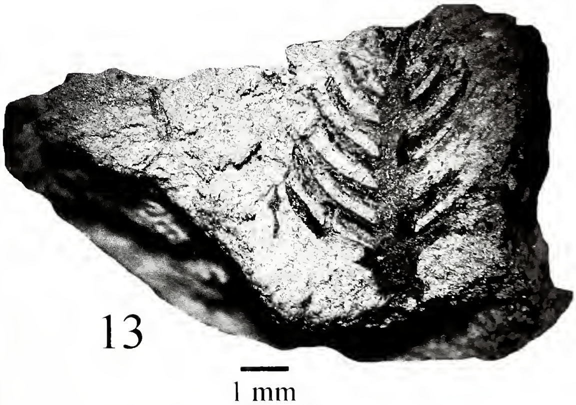
Compared to other Late-Pleistocene and Holocene aquatic sediments studied in Indiana, the diversity of macrofossil remains at the Shafer site is very low. Mean macrofossil species richness for 15 other Late-Pleistocene and Holocene deposits studied by Swinehart (2002) was 15.6 (min. = 8; max. = 25, S.D. = 4.4). However, with the exception of *Myriophyllum*, the taxa that were recovered at the Shafer Locality are common in other deposits in Indiana, including sites harboring mastodonts and other ice-age megafauna (Whitehead et al. 1982; Jackson et al. 1986; Swinehart & Richards 2001; Swinehart 2002). *Myriophyllum* has been reported at the Christiansen Mastodont Locality in central Indiana by Whitehead et al. (1982), in central Michigan by Oltz & Kapp (1963), and recently in Late-Pleistocene and Holocene sediments at Tamarack Bog, north of High Lake, in Noble County, Indiana, and the Buesching Mastodont Locality in Allen County, Indiana (Swinehart unpubl. data).

Reconstruction of the palaeoenvironment.

Extra-local & regional palaeoenvironment.—The vegetation record from the Shafer Mastodont Locality extends back to 15,540 ybp, beginning perhaps only 500 years after deglaciation, and is summarized in Fig. 14. Based on the radiocarbon dates, known glacial chronology, and presence of boreal flora (including black and white spruce, tamarack, pine, and possibly fir and cedar), the climate of the Shafer Locality during the time of the mastodont (lowermost portion of the pollen record) likely had similarities to that which predominates in the modern coniferous forest biome in northern Michigan and southern Canada. While black spruce was not found in the macrofossil assemblage it is likely that







Figures 8–13.—Macrofossils recovered from the Shafer Mastodont Locality, Warren County, Indiana. 8. Cone of *Picea glauca*; 9. "Spur" with leaf scars of *Larix laricina*; 10. Side view of an achene of *Potamogeton pusillus*; 11. Top (12) achene of *Najas flexilis*; 13. Imprint and organic remains of a leaf of *Myriophyllum* cf. *M. exalbescens* in silt matrix.

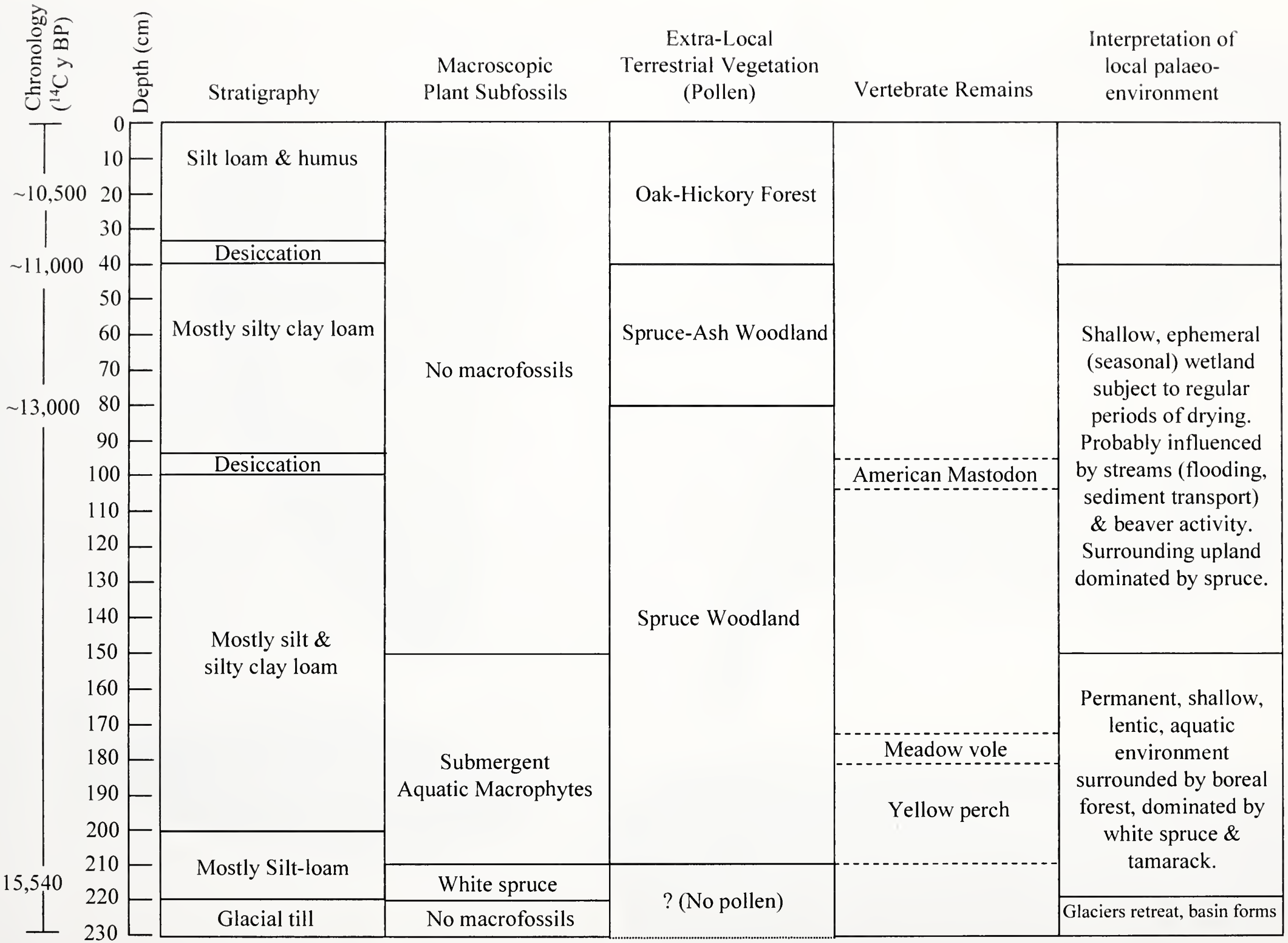


Figure 14.—Diagram summarizing the chronology, stratigraphy, macrofossils, pollen, vertebrate remains, and interpretation of the palaeoenvironment of the Shafer Mastodont Locality, Warren County, Indiana.

black spruce was growing locally since it has been shown to be present elsewhere in the region during late-glacial time (Whitehead et al. 1982; Jackson et al. 1986; Swinehart 1995).

The herbaceous pollen is low without any indication of tundra taxa (e.g., *Dryas*). From the pollen diagram it is clear that the bulk, if not all, of the Holocene record is missing. The top of the record is estimated to be 10,500 ybp based on the persistence of the spruce in the record. This truncation of the sequence is not uncommon for this region or time period (Whitehead et al. 1982; Jackson et al. 1986). In the case of the Shafer Mastodont Locality the basin might have filled in by 10,000 ybp or the water table may have dropped at this time or later. One scenario is that the water table dropped at the beginning of the Hypsithermal between 9000–8000 ybp and that subsequent erosion resulted in the loss of the most recently deposited sediments.

Interpretation of the sand layer is aided by the pollen stratigraphy and by comparison to records from Chatsworth Bog (King 1981). Based on these sources, the sand layer at the Shafer Mastodont Locality would likely date to greater than 13,000 ^{14}C ybp and less than 15,000.

As has been noted in other studies (i.e., Whitehead et al. 1982), *Fraxinus* pollen has been misidentified as *Salix* in some earlier studies. This was likely the case by Richards (1938) in her study of Otterbein Bog. In the pollen diagram from Otterbein Bog, *Salix* is shown to peak immediately following the decline of spruce. A similar peak is present in more recent studies and is correctly identified as ash (King 1981; Whitehead et al. 1982; Jackson et al. 1986; Shane 1987). Ash pollen is distinguished from willow by the lack of a psilate furrow margin, present in willow pollen. This rise in ash is most likely attributed to black ash, which is typical of wetlands and has been identified in other studies.

The slight rise in *Ambrosia* pollen at 90–100 cm depth might indicate an opening of the forest canopy associated with the decline of spruce (perhaps by fire after the desiccation event) and prior to the expansion of ash. An alternative explanation is that the *Ambrosia*, Cyperaceae, and Poaceae pollen are from long-distance transport from an expanding grassland to the west.

With the addition of palynological analysis of the sediments above the cone zone it is possible to place the section and lithologic transitions into a regional chronology. The upper 25 cm of the profile is difficult to interpret due to conflicting signals within this zone. First, the rise of *Quercus* and *Carya* records the development of a post-glacial oak-hickory forest, however, at the same time there is a rise in *Picea* and *Pinus*, as well as *Ambrosia*-type, typical of both late-glacial and post-settlement records. The rise in *Picea* at the surface may be 1) "antiquing" of the sequence due to erosion from surrounding older sediments, 2) a "climatic reversal" suggested by Shane (1987) in Ohio at the Pyle and Stotzel-Leis Sites, or 3) contributions from extremely local sources such as peatlands, which often provide microhabitats for northern conifers.

Finally, the decline of spruce at 13,000 ybp as determined by Shane (1987), and King (1981) correlates with a dramatic positive shift in the ^{18}O isotope curves (equates to warmer temperatures) from Greenland ice cores and Switzerland lake sediments (Paterson & Hammer 1987).

Local palaeoenvironment.—Reconstruction of local conditions may be best aided by the study of macrofossils because they are less likely than pollen to have traveled long distances. A summary of the interpretation of the local paleoenvironment is provided in Fig. 14. The presence of abundant macrofossils of white spruce and tamarack in the lowest strata of the Shafer locality suggests a nearby terrestrial environment, initially. The presence of two small fish vertebrae within the floral debris suggest possible deposition in water. White spruce are boreal trees common in well-drained uplands and lakeshores. Black spruce (*Picea mariana*), on the other hand, are more common in poorly-drained lowlands. Although pollen of black spruce was found at the Shafer Locality, macrofossil remains were not recovered, suggesting relatively well-drained conditions locally. The poor diversity and preservation of macrofossils at the site might be further indication of well-drained soils. The abundance of tamarack macrofossils could be viewed as evidence for poorly-drained wetland soil, but similar boreal environments of today harbor tamarack in a wide range of soil conditions. Potzger and Wilson (1941) hypothesize that *Larix* may have been sub-dominant to spruce even though not evident from pollen assemblages (due to the tendency of *Larix* pollen to decompose readily in water). The abundance of *Larix* macrofossils in both the Shafer sediments as well as the Kolarik and Christensen sites (Whitehead et al. 1982; Jackson et al. 1986) may be evidence of this, and might represent a regional rather than a local association. The infrequent achenes of *Potamogeton pusilus* and *Najas flexilis* and the fragments of *Drepanocladus aduncus* in the cone zone may have been deposited and incorporated after subsequent inundation of the site.

Strata superceding the cone-bearing layer are successively more indicative of submergent conditions. Conifer remains become scarce while the richness and abundance of aquatic macrophytes increase. The early aquatic environment was characterized by permanent standing water, as evidenced by the presence of fish bones and macrofossils of submergent aquatic plants (*Myriophyllum*, *Potamogeton*, *Najas*, and *Ceratophyllum*) and algae (*Pediastrum*). The presence of fish so early in the sedimentary record suggests that the water-body was in contact with, or in close proximity to, an aquatic system (possibly lotic) which acted as a migration route or as a transport medium for carcasses. However, despite extensive screen-washing of the sediments there were few elements of individual fishes. This suggests that entire animals did not remain buried *in situ*, but rather were either dispersed along the fringe zone ("shelf") around a deeper kettle or transported into the site by lotic systems or floodwaters. The lack of fishes in middle and upper strata may suggest little subsequent "seeding" of the basin by connecting waterways. Although streams may have influenced the subfossil assemblage, the aquatic macrophyte taxa recovered suggest that the prevailing conditions in the basin were lentic rather than lotic.

The transition to more aquatic conditions suggests a marked rise in the local or perhaps regional water table. Three possible explanations for this transition are proposed: 1) aquatic conditions could have prevailed from the beginning, and the white spruce and tamarack remains were deposited in the water from the surrounding upland, 2) the cone layer could represent a terrestrial forest that existed on overburden of a buried ice-mass that later melted and created a water-filled depression with associated aquatic flora, and 3) the cone layer could represent a terrestrial environment that was later subject to paludification from increases in meltwater from the retreating glacial ice to the north or from beaver activity. The first hypothesis would suggest that boreal trees retreated locally because their macrofossil remains were restricted to a narrow stratum at the base of the sedimentary profile. The second hypothesis seems unlikely because the depth of the sedimentary profile is only 2.3 m, and therefore, it is unlikely that the overburden could have sufficiently insulated such a thin ice mass long enough to allow a forest to colonize above it. The third hypothesis seems most likely and is consistent with other biotic and abiotic phenomena encountered higher in the profile (see below).

Identifiable macrofossils became rare and ultimately absent in successive strata, yet deposition of organic sediments characteristic to wet environments continued through most of the profile. The elimination of identifiable macrofossils is attributed to increased oxidation during and/or subsequent to the deposition of the sediments, facilitating decay. Such conditions can occur in extremely shallow waters where oxygen diffusion at the surface is sufficient to oxidize sediments, or when standing water becomes only seasonal, and dry periods expose sediments to the atmosphere. Two hypotheses are proposed to explain the eventual increase in oxidation of the sediments at the Shafer Locality: 1) autogenic factors such as filling of the basin with sediment reduced water depth, or 2) allogenic factors depleted the water source (reduction of glacial meltwater, stream diversion, beaver activity, etc.), but irregular or seasonal fluxes maintained wetland conditions.

SYSTEMATIC PALAEOBIOLOGY OF VERTEBRATES

Phylum Chordata
(Subphylum Vertebrata)
Class Osteichthyes
Order Perciformes
Family Percidae

Perca flavescens
(Yellow Perch (INSM Cat # 71.3.224.1))

Material: Left dentary (Fig. 15). *Occurrence:* NW bench, 20–30 cm above cone zone (Unit XI). Recovered from 1.2 mm mesh screen washing of bulk sediments. *Comments:* The jaw represents a small individual of perhaps 140 mm standard length. Its detail closely matches details of three reference specimens, particularly on the lingual face, bony boss on the supero-anterior rim of the jaw, details of foramina on the buccal surface, and midline lateral angularity along the jaw length. *Habitat:* The yellow perch is most common near vegetation in clear waters of lakes, ponds, pools of creeks and small to large rivers (Page & Burr 1991). It has a relatively northern distribution.

Fish, sp. indet. INSM Cat #71.3.224.2)

Material: Two partial vertebral centra. *Occurrence:* NW bench, Cone Zone (Unit XI). Recovered from 1.2 mm mesh screen washing of bulk sediments. *Comments:* One partial vertebral centrum (Fig. 16) represents a fish similar in size to the above perch, and the other is from a smaller fish.

Class Mammalia
Order Rodentia
Family Cricetidae

Microtus pennsylvanicus
(Meadow Vole) (INSM Cat # 71.3.224.3)

Material: Upper R molar 3, lacking portion of anterior loop (Figs. 17, 18). *Occurrence:* NW bench, 20–30 cm above Cone Zone (Unit XI). Recovered from 1.2 mm mesh screen washing of bulk sediments. *Comments:* The tooth enamel pattern consists of an anterior crescent, three alternating closed triangles, and two posterior lingually-directed loops that are confluent laterally. This pattern is shared by *Microtus pennsylvanicus* and *M. xanthognathus*, though the latter lacks cementum in the posterior-most lateral re-entrant angle (Hallberg et al. 1974). The cementum has been leached from most of the re-entrant angles of the Shafer fossil, but its size is relatively small (1.9 mm + in length). Semken (1984) showed that M3's of *M. pennsylvanicus* in Peccary Cave, Arkansas, did not exceed 3.2 mm, while those of *M. xanthognathus* exceeded 3.55 mm in length. *Habitat:* The meadow vole frequents low moist areas or high grasslands with rank growths of vegetation and is found near streams, lakes, swamps and occasionally in forests with little ground cover (Burt & Grossenheider 1964).

Microtus, sp. indet.
(Vole (INSM Cat # 71.3.224.4))

Material: Left upper M1 (Figs. 19, 20) and R upper M1, and partial upper tooth (3 triangles). *Occurrence:* NW bench, 20–30 cm above Cone Zone. Recovered from 1.2 mm mesh screen washing of bulk sediments. *Comments:* These teeth are undiagnostic to species, and could well represent the same individual of *M. pennsylvanicus*.

Order Proboscidea
Family Mammutidae
Mammut americanum

American mastodont
(INSM Cat # 71.3.131.1–71.3.131.5)

Material: Major portions of mandible, including lower L and R molars 2 and 3 (Figs. 20–24). *Occurrence:* Because the mandible was disturbed by the backhoe, its original location is uncertain. It would have occurred somewhere above the floor of the original backhoe trench that extends 150–160 cm below the surface on Profile 4. However, dark loam impacted into the cancellous bone of the mandible suggest burial in the brown silty clay loam (Unit IV) which fills the fissures in the clay loam (Unit V) of Sediment Division C. In addition, jaw fragments, thought to be *in situ*, were encountered just above floor #1, approximately 74 cm below the surface at an interface where dark loam penetrated fissures in the clay near the east end of Profile 1. The mandible appears to be part of Unit IV fill, deposited into the fissures of silty clay loam of Unit V. Whether the jaw was intact and moved as a unit, or whether spalled fragments worked down into the fissured Unit V at different rates is uncertain. It is less probable that the mandible was deposited in Unit V clay, and was intercepted by a fissure that afterwards filled with the dark loam of Unit IV from above. In either case, the mandible was deposited relatively late in the stratigraphic sequence. *Comments:* The jaw was likely deposited after the formation of Unit V lake sediments. This would correlate with a time later than the pollen sample at 40 cm (Unit V), dominated by oak-hickory and estimated to be just under 11,000 ybp, and earlier than the pollen sample at 30 cm (Unit III), with a stronger oak-hickory component, and estimated age of well over 10,500 ybp. In the event

Figures 15–24.—Vertebrate fossils from the Shafer Mastodont locality, Warren County, Indiana. 15. *Perca flavescens* (yellow perch), left dentary (71.3.224.1); 16. Fish, sp. indet., partial vertebral centrum (71.3.224.2); 17, 18. *Microtus,* sp. indet. (vole), left upper M1 (71.3.224.4, occlusal and lingual views, respectively); 19, 20. *Microtus pennsylvanicus* (meadow vole), right upper M3 (71.3.224.3, occlusal and labial views, respectively; 21, 22. *Mammut americanum* (American mastodont), partial mandible, left ramus with M2 and M3 (71.3.131, left lateral and occlusal views, respectively), scale in cm; 23, 24. *Mammut americanum*, lower right M3 (71.3.131.5; labial and occlusal views, respectively), scale in cm.

Table 2.—Tooth measurements (mm), Shafer Mastodont, Warren County, Indiana.

Catalogue # Tooth placement	71.3.131.3 L molar 3	71.3.131.5 R molar 3	71.3.131.2 L molar 2	71.3.131.4 R molar 2
Greatest length	184.5	184	112	114
Greatest width	96.5	96.3	8	88.5
Width across protolophid	85.7	85.5	75.6	73.9
Width across metalophid	96.1	95.4	84.2	83.9
Width across tritolophid	92	92	84.3	82.6
Width across tetralophid	78.1	76	n/a	n/a

that the jaw did occur in the silty clay loam of Unit V, the spruce-ash woodland would have been dominant, with an age up to slightly over 13,000 ybp. The lowermost sediments of Unit V, however, were dominated by spruce woodland.

Tooth wear suggests age class XX (Laws 1966), indicating a middle-aged mastodont of 34 ±2 African elephant years of age. Tooth measurements (Table 2) follow the terminology of Saunders (1977). The teeth of the Shafer Mastodont are small when compared to those from Michigan (Skeels 1962). They are less than the average size of the Bony Spring, Missouri, sample (Saunders 1977), yet are larger than the Trolinger Spring, Missouri, average (Saunders 1977). The teeth of the Shafer Mastodont share the small size of the Christensen (Graham et al. 1983) and Aker (Richards et. al. unpubl. data) mastodonts from Indiana, and contrast with the larger Dollens (Richards et al. 1988) and Lewis (Hunt & Richards 1993) specimens. Characters of the skull used to differentiate sex in the mastodont (Osborn 1936) suggest that the Christensen materials were female (Graham et al. 1983). Male mastodonts were of greater stature than females (Kurten & Anderson 1980), suggesting that the Aker mastodont, of small adult stature, was a female (Richards et al. unpubl. data). Although the large sample of teeth from Missouri are not bimodal in size and do not readily demonstrate sexual dimorphism (Saunders 1977), the small size range of the Shafer Mastodont teeth compared with those of probable Christensen and Aker females, suggest that the Shafer mastodont is likely a female.

The fractured mandible produced only two standard measurements: Greatest transverse width, L condyle, 164 mm; greatest anteroposterior length, L condyle, 64.5 mm. *Habitat:* The mastodont is thought to have inhabited open spruce woodlands and spruce forests (Kurten & Anderson 1980).

TAPHONOMY OF THE SHAFER MASTODONT

Like many mastodonts recovered from the region, the Shafer specimen died over 10,000 ybp and was deposited in shallow aquatic sediments of lentic origin. Unconformities in the sedimentary record occur just above the stratum where the mastodont element was recovered, and the profile was ultimately truncated around 10,000 years ago. The unconformities in the upper portions of the profile are likely a combination of the disappearance of the wetland in the early Holocene by both autogenic and allogenic factors and eventual alteration of the soil by human activity in the nineteenth and twentieth centuries.

The isolated mastodont mandible (with teeth) was the only mastodont element recovered at the locality, despite extensive exploration with heavy equipment. There is no obvious macroscopic evidence of gnawing or scavenging on the mandible that could suggest exposure before burial. Hill (1979) related that the mandible is usually one of the earliest elements to separate from the skeleton of the African antelope *Damaliscus*, and that the vertebrae, separating last, are the bones that remain longest at the death site. This same disarticulation sequence was confirmed with several other African mammal taxa (Hill & Behrensmeyer 1984). Experimenting with bone movement in running water, Voorhies (1969) related that such items as ribs, vertebrae, and sometimes scapulae, ulnae and phalanges (transport Group I) were removed first by flotation or saltation. His group II bones included the pelvis, humeri, radii, femora, tibiae, metapodials, and sometimes scapulae, mandible, ulnae, and phalanges, which moved slowly by traction. Group III included the cranium and sometimes the mandible as lag deposits. Hill's scenario could suggest that the mandible of the Shafer Mastodont had separated from and moved away from the main skeleton, perhaps leaving vertebrae nearer the original site of deposition. Voorhies' scenario might indicate that the skull of the Shafer Mastodont, and perhaps mandible, would remain as lag at the site of deposition, with the other elements dropping into the kettle basin by moving water. The relationship of disarticulation and scattering was noted by Hill (1979), who related that the bones that separated first are among the most difficult to remove by running water—as is the case with the mandible of the Shafer Mastodont. The lack of the massive skull or tusks that should accompany the mandible as lag on the "shelf" does not support a scenario where the remaining skeleton had washed into the deeper kettle basin, particularly since the extensive deep trenching of the backhoe failed to recover a single mastodont bone. It seems more likely that: 1) the mandible, separated early from the skeleton, moved onto the shelf from an upland source where the remaining skeleton was scattered, and perhaps unburied, thereafter disintegrating, or 2) the mandible detached from a floating carcass during a temporary flood event. It is speculation that the mandible could have been moved to position by other animals, as African elephant skeletons have been scattered up to 50 m from the death site by trampling, scavengers, and elephants which are known to carry bones and tusks for some distance (Coe 1980). As the wetland sediments of Unit V dried, the dark silty clay loam soils carried the mastodont mandible as part of the fill into the desiccation fissures. Less probably, the mandible was earlier deposited into the wetland sediments on the shelf, and later penetrated by dark loam seams from above as the surrounding sediments dried and cracked. A similar lack of smaller elements and suggested upland skeletal source was proposed for the Dollens Mastodont (Richards et al. 1988).

ACKNOWLEDGMENTS

Property owner Larry Shafer thoughtfully suspended the laying of drainage tile when the mastodont bone was uncovered, contacted authorities, participated in daily excavations with his backhoe, and donated all materials to the Indiana State Museum. R. Criss Helmkamp, Purdue University, reported the discovery to the Indiana State Museum and aided with the benchmark survey. Indiana State Museum staff and volunteers provided field labor, supported by Randy Patrick and students from Southmont High School, Luke Hunt and students from Whitko High School, and students from Purdue and Ball State Universities.

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INSECTS AND OTHER ARTHROPODS OF ECONOMIC IMPORTANCE IN INDIANA IN 2004

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ABSTRACT. Indiana experienced a number of exotic invasive insects of regulatory concern in 2004. Among the species are emerald ash borer, European Sirex woodwasp, Asian ambrosia beetle, two species of longhorned beetles from China, banded elm bark beetle, and *Cydella* (Tortricidae) and *Chlorophorus* (Cerambycidae) from Indian pine cones. Pine shoot beetles were discovered in five more counties in 2004. The majority of Indiana's corn crop was planted and harvested earlier than usual in 2004. The western corn rootworm beetle variant pushed its way southward during 2004; and, as a result, for the first time poses moderate risk to first year corn in central and south Indiana counties in 2005. Generally, reports of fruit and vegetable-damaging insects were slightly lower than normal in 2004. Apple pests, including codling moth and spotted tentiform leafminer, were conspicuously absent throughout much of the state. The insect event of the year in 2004 was the mass emergence of Brood X, the 17-year periodical cicada, *Magicicada* spp., in much of the central and southern parts of the state. Insects in lawns and golf courses were less of a problem in 2004 than usual. Japanese beetles emerged earlier than normal in 2004; and some high, localized populations existed.

Keywords: Periodical cicada, emerald ash borer, exotic invasive insects

GENERAL WEATHER OVERVIEW

Indiana experienced a comparatively mild winter in 2004. Accumulated growing degree days were higher than normal in late winter and early spring than in prior years (Indiana Agricultural Statistics 2004). Unusually wet weather conditions developed in early-to-mid spring of 2004 and persisted across most of the state causing localized flooding in many areas. Precipitation continued throughout most of the growing season (spring and summer) and then ceased in early September for 4–5 weeks, allowing soils to dry out.

AGRICULTURAL INSECTS

Bean leaf beetle (*Certoma trifurcata* (Forster)) damage on soybeans was isolated and localized. Soybean leaf aphid (*Aphis glycines* Matsumura) populations were much lower in 2004 than the previous year. Lack of synchrony between the development of the aphid and the plant, as well as the absence of south winds during the migratory phase of the aphid resulted in minimal new movement in 2004 as compared with 2003. Asian lady beetle (*Harmonia axyridis* (Pallas)) populations in soybean fields were low during 2004 probably due, in large part, to the decreased abundance of soybean aphids. Lack of aphids also mitigated the nuisance problems with syrphid flies (Diptera: Syrphidae) that Indiana residents experienced in 2003.

The majority of Indiana's corn crop was planted and harvested earlier than usual in 2004. Corn earworm (*Heliothis zea* (Boddie)) normally a late season pest, did not develop during 2004. The western corn rootworm beetle variant (*Diabrotica virgifera virgifera* LeConte) pushed its way southward during 2004 and, as a result, for the first time poses moderate risk to first year corn in central and south Indiana counties in 2005. European corn borer (*Ostrinia nubilalis* Hübner) numbers have been falling over the last three years, possibly due to wet spring seasons. Estimates based on stalk splitting in late 2004 indicate that populations of European corn borer are the lowest recorded in many years. A lower population of corn borers went into the winter of 2004, suggesting a lower threat again in 2005 (although the ultimate 2005 population may be more dependent upon spring and early summer growing conditions than on the size of the population going into winter). True armyworm (*Pseudaletia unipuncta* Haworth) was found in an isolated area on early field corn, indicating a probability of a single early heavy flight event from the southern states. However, armyworm infestations were not as severe or as widespread as was the case in 2001.

In alfalfa, the alfalfa weevil (*Hypera postica* (Gyllenhal)) population and damage were moderate to light (similar to 2003). Potato leafhopper (*Empoasca fabae* (Harris)) populations were high in 2003 and started out heavy in 2004, but cool rains and possibly fungal infections hampered the buildup of this pest. Populations continued to decline as the year progressed.

Pest activity that is new and unusual includes corn leaf blotch miner (*Agromyza parvicorreis* Loew) in isolated areas. Southcentral Indiana may be experiencing higher wireworm (Coleoptera: Elateridae) problems possibly due to the changing farming practices of that area. The use of silage from winter wheat and a second crop of corn (both cut green) leaves the soil full of decomposing grass roots throughout the entire growing season. This practice provides abundant food for wireworm larvae.

BEEKEEPING

In general, Indiana experienced excellent weather for beekeeping in 2004. There was sufficient rain throughout the season (until September), but there was also plenty of sunny weather for bees to forage on flowers. Most beekeepers removed surplus honey in August, but the bees were able to produce more honey for overwintering. A lack of rain from September to early October caused the fall flowers (primarily goldenrod and aster) to quit producing nectar slightly earlier than normal. As a result, some Indiana hives were light on honey stores in the fall due to the September drought-like conditions; but the situation is not as bad as it was during 2003. Varroa mites (*Varroa destructor* Anderson & Trueman) and tracheal mites (*Acarapis woodi* (Rennie)) are a problem throughout the state. Small hive beetle was found to be locally established in LaPorte County.

EXOTIC INVASIVE INSECTS OF REGULATORY CONCERN IN AGRICULTURE

Old world bollworm, *Helicoverpa armigera* (Hübner), surveys were initiated in 2004 under the Indiana Cooperative Agricultural Pest Survey (CAPS) program. *Helicoverpa armigera* is a highly polyphagous pest of many economically significant crops in Africa, Asia, Australia, and Europe. It feeds on over 180 wild and cultivated species, including corn and soybean. Approximately 49% of the continental U.S. provides suitable habitats. *Helicoverpa armigera* is not known to occur in the United States. No specimens were collected, and surveys will continue in 2005.

EXOTIC INVASIVE INSECTS OF REGULATORY CONCERN IN NATURAL RESOURCES

Emerald ash borer (*Agrilus planipennis* (Fairmaire)) was the most significant invasive insect during 2004. Both LaGrange County and Steuben County have townships under quarantine due to this pest. On 19 April 2004, IDNR and USDA APHIS placed Jellystone Campground, Fremont (Steuben County: Jamestown Township) under quarantine. On 26 May 2004, IDNR and USDA APHIS placed LaGrange County: Clay Township under quarantine. On 22 August 2004, IDNR and USDA APHIS placed part of LaGrange County (Van Buren Township) under quarantine. In the spring of 2004, Winchester (Randolph County) received nursery stock containing a dead adult emerald ash borer. It was ruled as a regulatory interception, and surveys were initiated for detection of emerald ash borer. On 17 November 2004, IDNR and USDA APHIS placed Manapogo Campground (Steuben County: Millgrove Township) under quarantine.

Emerald ash borer has been introduced into Indiana by three different pathways. In Steuben County, emerald ash borer was most likely introduced in firewood from Michigan. In LaGrange County, emerald ash borer was most likely introduced by infested ash trees that were brought into a local lumber mill. In Randolph County, emerald ash borer was introduced into the county from infested nursery stock. An estimated 40,000 ash trees will be removed in the quarantined townships of LaGrange County and Steuben County by the spring of 2005. Six percent of all forest trees in Indiana are ash, a total about 150 million ash trees. In addition, urban areas in Indiana are comprised of up to 40% ash, where they have been heavily used for street trees, in parks, and in both public and home landscaping. IDNR, USDA APHIS, Purdue University, and USDA Forest Service have ongoing research and surveys for emerald ash borer that will continue in 2005.

European gypsy moth (*Lymantria dispar* Linnaeus) trappings were down 75% in total number from 2003. Indiana Department of Natural Resources (IDNR) will possibly treat 21,000 acres in 2005 for gypsy moth. The Indiana Department of Natural Resources and the USDA Forest Service participate in the STS (Slow the Spread Program). The European gypsy moth first appeared in Indiana in the early 1970s. European gypsy moths in Indiana are concentrated in the northeast part of the state, but populations do appear elsewhere. In 2003, male gypsy moths caught in traps were 23,090; however, in 2004, the number of male gypsy moths caught in traps declined to 8971. In 2004, IDNR treated 39 sites for the European gypsy moth. In 2005, IDNR will possibly treat 22 sites (21,000 acres) with pheromone disruption flakes and *Bacillus thuringiensis* subspecies *kurstaki* sprays.

EXOTIC INVASIVE INSECTS OF REGULATORY CONCERN IN NURSERIES

Indiana was inundated with a number of exotic invasive insects of regulatory concern in 2004. Asian ambrosia beetles (*Xylosandrus crassiusculus* (Motschulsky)) were collected during Indiana Department of Natural Resources (IDNR) nursery inspections in 2004. Asian ambrosia beetles are known to occur in Jackson and Bartholomew counties in Indiana; suspect specimens were collected in Boone, Hendricks, Johnson, and Monroe counties. No regulatory action has been taken for this pest. Host plants for the Asian ambrosia beetle include over 120 known plants, which include: pecan, Chinese pistachio, red oak, bur oak, redbud, Bradford pear, and chinquapin oak. Females bore into plant trunks and inoculate the tunnel with fungal spores. The females then produce a brood. The larvae and the females feed on the fungus, not the host. Heavily-infested plants usually die from the inoculated fungus or a secondary disease.

Due to infestation by the pine shoot beetle (*Tomicus piniperda* Linnaeus), five new counties (Decatur, Jennings, Ripley, Union, and Vigo) in southern Indiana were added and placed under quarantine in 2004. Currently, 60 of the 92 counties in Indiana are under quarantine for this pest. Pine shoot beetle was first reported in the U.S. (including Indiana) in 1992. Pine shoot beetles do not harm sawed timber but require live or very recently-killed pine trees in order to feed and reproduce. Damage from the this beetle is usually limited to killing several shoots approximately 10–15 cm in length on a tree. The beetles can kill already-stressed trees and may weaken and kill healthy trees when populations get very high.

EXOTIC INVASIVE INSECTS OF REGULATORY CONCERN IN STORES

The United States Department of Agriculture (USDA) Animal and Plant Inspection Service (APHIS) issued a national recall on imported pine cones originating in India. These pine cones were sold both singly and in potpourri as a specialty holiday item. The recall was issued because they harbor two different insect pests: the slender banded pine cone longhorned beetle (*Chlorophorus strobilicola* Champion)—a wood-boring beetle native to India, and larvae of a seed-feeding moth belonging to the genus *Cydella*. On 18 December 2003, there were 21 potpourri products listed in the recall; however, the number of recalled potpourri products continued to expand as state and federal inspectors located additional products. Pine cones infested with live insects were found in at least 11 states, including Indiana, New Jersey, New York, Maryland, and Delaware. APHIS will now require mandatory fumigation for all pine cones from India entering U.S. ports of entry. Products packaged in impermeable wrappers will be refused entry unless they are removed from the packaging to allow effective treatment. *Chlorophorus strobilicola* was not found in Indiana; however, several *Cydella* moths were collected.

The United States Department of Agriculture (USDA) Animal and Plant Inspection

Service (APHIS), Plant Protection and Quarantine (PPQ) officers found live insect larvae in a product known as "Rustic Twig Tower™" imported from China. The initial find was made in Wisconsin by a concerned consumer who purchased this product. The larva was identified as an exotic invasive longhorned beetle (Cerambycidae: Lamiinae). In addition to this infestation, a consumer in Florida reported finding insect larvae in the same product. This product contained numerous insect larvae that were identified as a different exotic invasive longhorned beetle (Cerambycidae: Lamiinae). USDA APHIS is very concerned about the introduction of these two insect pests into the United States. The sub-family Lamiinae is known to infest hardwood trees, and the sub-family Cerambycinae is known to infest softwood trees such as sequoia, bald cypress, and other similar species. IDNR Division of Entomology and Plant Pathology recovered eight Rustic Twig Tower's™ from around the State of Indiana.

In December of 2004, the USDA recalled artificial Christmas trees with real-bark trunks manufactured by Polytree Hong Kong Co. Ltd. The Christmas trees imported from China contained a quarantined significant pest, the brown fir longhorned beetle (*Callidiellum villosulum* (Fairmaire)) found in shipments in Illinois and Michigan. The adult beetles were removed from the wooden portion of the artificial trees sold in a "Michael's" craft store. The product was traced back to the Polytree Company in China. Polytree was also involved with a recall on similar artificial trees sold at Ace Hardware. The recall notice instructs consumers to return these trees to the stores in which they were purchased. Further investigation by USDA APHIS found that heat treatment certificates accompanying the two shipments indicate the treatment conducted did not meet U.S. entry requirements.

EXOTIC INVASIVE INSECTS OF REGULATORY CONCERN IN SOLID WOOD PACKING MATERIALS

Surveys continued for the European woodwasp (*Sirex noctilio* Fabricius) in Bloomington, Indiana in 2004. *Sirex noctilio* was found inside a factory warehouse there in 2002. Surveys for *S. noctilio* are in their third year in that city, but to date no *S. noctilio* specimens have been collected. *Sirex noctilio* infests all major commercial pine species. The female wasp drills into the wood and inserts a toxic mucus and the fungus, *Amylostereum areolatum* (Chaillet) Boidin, into the tree. The mucus prevents the tree from defending itself against the fungus. The fungus grows and causes the tree to dry out (weeks to months). The combination of fungus and mucus kills the tree.

A "Hot Zone" survey between the USDA APHIS PPQ and the Indiana CAPS program targeted invasive Solid Wood Packing Material (SWPM) pests at 55 sites in Indiana in 2004. Traps were set at sites that are believed to have risk for the introduction of exotic invasive bark, jewel, and woodboring beetles. Twenty exotic invasive bark, jewel, and woodboring beetles that threaten Indiana natural resources were targeted in this survey that will continue in 2005 (Table 1). No pests targeted in the SWPM survey were collected; however, banded elm bark beetles (*Scolytus schevyrewi* Semenov) were collected in Marion County through this survey. No regulatory action was taken for this pest. The banded elm bark beetle affects elms and autumn olive—among other plants.

FRUIT AND VEGETABLE INSECTS

Generally, fruit and vegetable damaging insects were slightly lower in 2004 than normal. Apple pests, including codling moth (*Cydia pomonella* (Linnaeus)) and spotted tentiform leafminer (*Phyllonorycter blancardella* (Fabricius)) were conspicuously absent throughout much of the state. European corn borer (*Ostrinia nubilalis* Hübner) damage to sweet corn and other crops was reduced. When first generation flights are low, the second generation of corn borers does not develop in numbers high enough to cause injury to sweet corn. Corn earworm (= tomato fruitworm), *Heliothis zea* (Boddie), populations were low throughout the state in the early 2004 season. However intense tropical storm activity in the southern states accounted for a higher influx of earworms into Indiana during the late summer and resulted in some late season damage.

Table 1.—List of target bark, jewel, and woodboring beetles surveyed for in the "Hot Zone" survey in 2004.

Scientific name:	Common name:
Agrilus planipennis Fairmaire	Emerald ash borer
Anoplophora chinensis (Forster)	Citrus longhorned beetle
Anoplophora glabripennis (Motchulsky)	Asian longhorned beetle
Callidiellum rufipenne (Motschulsky)	Small Japanese cedar longhorned beetle
Chlorophorus annularis Fabricius	Bamboo/Tiger bamboo longhorned beetle
Hesperophanes (*Trichoferus*) *campestris* (Faldermann)	Chinese longhorned beetle
Hylurgops (*Hylurgus*) *palliatus* Gyllenhal	Exotic bark beetle
Hylurgus ligniperda (Fabricius)	Golden-haired dark beetle
Ips sexdentatus (Boerner)	Six-spined engraver beetle
Ips typographus (Linneaus)	European spruce bark beetle
Monochamus alternatus Hope	Japanese pine sawyer beetle
Orthotomicus erosus (Wollaston)	Mediterranean pine engraver beetle
Pityogenes chalcographus (Linnaeus)	Six-toothed spruce engraver
Tetropium castaneum Linnaeus	Black spruce beetle
Tetropium fuscum (Fabricius)	Brown spruce longhorned beetle
Tomicus minor (Hartig)	Lesser pine shoot beetle
Tomicus piniperda (Linnaeus)	Common pine shoot beetle
Trypodendron domesticum (Linnaeus)	European hardwood ambrosia beetle
Xyleborus spp.	Exotic bark beetles
Xylotrechus spp.	Exotic longhorned beetles

HOUSEHOLD AND STRUCTURAL (URBAN) INSECTS

The number of complaints about social and solitary wasps around homes was slightly higher in 2004, despite early rains. The number of complaints about spiders around homes and other buildings was common in 2004, but complaints were not as common as during 2003. Box-elder bug (*Boisea trivittatus* (Say)) complaints were higher than normal (similar to 2003). Elm leaf beetles (*Xanthogaleruca luteola* (Müller)), home-invading weevils (black vine weevil (*Otiorhynchus sulcatus* (Fabricius)), and strawberry root weevil (*Otiorhynchus ovatus* (Linnaeus)) were extremely low during 2004.

The number of calls from homeowners regarding termites and ants was lower than usual this year. Wet organic matter in yards and gardens near residences promoted the survival of high numbers of millipedes, sowbugs and pillbugs, especially during the spring and early summer time. Like in 2003, homeowners in 2004 often complained of these nuisance pests covering sidewalks, patio and garage floors and entering into basements through window cracks and utility ports. Over the northern and central regions of the state, earwigs (Dermaptera: Forficulidae) continue to be a common nuisance.

LANDSCAPE AND ORNAMENTAL INSECTS

The insect event of the year in 2004 was the mass emergence of Brood X the 17-year periodical cicada (*Magicicada* spp.) in several areas across the central and southern parts of the state. Some reports described thousands of cicadas emerging from the ground all at once. While in most situations this was merely a phenomenon, some complaints of damage were registered. Calls received ranged from complaints of damage to trees and shrubs because of the oviposition slits made by the female, to the unbearable noise of the cicadas calling, to even a few complaints of odor produced as the insects began decaying in mass. Three species of cicada (*Magicicada septendecim* (Linnaeus), *Magicicada cassini* (Fischer), and *Magicicada septendecula* Alexander and Moore) were involved in this mass emergence. Extension and media alerts throughout the emergence period helped to minimize the potential damage by this insect to small ornamental trees, nursery stock, and fruits. Advanced warnings allowed control strategies (including modifying chemical treatments, altering planting recommendations, and positioning netting material over susceptible trees) to be in place that prevented most severe cicada damage to commercial trees.

Numbers of most aphids and scales were low on ornamental plants. Webworms such as eastern tent caterpillar (*Malacosoma americanum* Fabricius), fall webworm (*Hyphantria cunea* (Drury)), and mimosa webworm (*Homadaula anisocentra* Meyrick) were higher than normal. Bagworms (*Thyridopteryx ephemeraeformis* (Haworth)), continued to create problems in spruce and other evergreen plantings and at many deciduous sites. Generally, spider mite (*Tetranychidae* spp.) activity was higher than usual, with spruce spider mites the most abundant.

PUBLIC HEALTH PESTS

Lower than normal tick and biting fly complaints were received during the spring and summer of 2004. Mosquito complaints were common early in the season, due primarily to the nuisance mosquito (*Aedes vexans* (Meigen)), during heavier rain periods. *Aedes japonicus japonicus* (Theobald) was reported in several southern and central Indiana counties. Overall, human-biting ticks and insects remained relatively quiet during 2004, except for the early season nuisance mosquito complaints. Reports of bed bug (*Cimex lectularius* Linnaeus) infestations have been more common during the past few years in Indiana. This mirrors the increase in bed bug activity nationwide and confirms the reported resurgence of true bed bug infestations especially in the hotel and bed and breakfast industry. Until recently, bat bugs (*Cimex adjunctus* Barber) dominated the number of cimicid-related calls.

STORED FOOD AND GRAIN INSECTS

More reports of psocids than normal occurred in stored grains and also in processed foods in 2004. Hairy fungus beetles (*Mycetophagus punctatus* Say) in stored foods were also higher, both probably due to the humid conditions of early 2004. Higher than usual foreign grain beetle (*Ahasverus advena* (Waltl)) activity was found both in stored grains and in new homes this year. New home construction during the wet spring conditions in early 2004 resulted in damp/wet wood becoming enclosed in wall voids and attics. Mold development in these conditions was highly conducive for supporting foreign grain beetle infestations.

TURFGRASS INSECTS

Insects in lawns and golf courses were a lesser problem in 2004 than usual. Japanese beetles (*Popillia japonica* Newman) emerged earlier than normal in 2004. Reports of some high, localized populations existed in the greater Marion County area. However, due to the moist growing conditions of the spring and summer, concentrations of the beetles doing damage to either plants, trees, or laying eggs in turfgrass were not evident. Spotty Japanese beetle damage was reported in berries, fruits and grains during 2004; however, lack of damage during early 2004 may be due to the abundance and diversity of host plants that competed for the beetle feeding. Billbugs (*Sphenophorous* spp.) in turfgrasses continue to increase in number and damage recently, even though their damage often goes misdiagnosed. Incidence of cluster fly (*Pollenia rudis* (Fabricius)), activity is also increasing.

Due to publicity by the media and warnings by extension specialists the impending threat of emerald ash borers (*Agrilus planipennis* Fairmaire) invading Indiana, more green beetles were submitted for identification during 2004 than previously. These included beetles such as carabids: fiery hunters (*Calosoma calidum* (Fabricius)), tiger beetles (Coleoptera: Cicindelidae), and green June beetles, (*Cotinis nitida* (Linnaeus)).

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THE SPIDER SPECIES OF THE GREAT LAKES STATES

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ABSTRACT. Critical analysis of existing spider species lists for Wisconsin, Michigan, Ohio, Indiana and Illinois reveals 900 species recorded from the five-state region (284 genera, 40 families). All non-native, Palearctic, or otherwise questionable species records were scrutinized, and their status is discussed. The most speciose families in the region are the Linyphiidae (almost 24% of species), Salticidae (10.3%), Theridiidae (8.9%), Lycosidae (8.8%), and Araneidae (7.7%). All sources used for spider species names and species records are unambiguously quoted. Spider species records are presented in tables allowing comparison of family composition among the states, and prediction of number of heretofore unrecorded species. Richness among states is analyzed and found to be dependent on varying degrees of sampling effort. As a new tool, a Spider Species Name Concordance Table allows tracking previously published spider species names to the currently valid name of every species record. The study demonstrates the need for crucial pieces of scientific infrastructure, such as complete species catalogs, and the great utility of faunistic and taxonomic data to meet today's biodiversity challenges.

Keywords: Midwest spider fauna, checklist, faunistics, Araneae, gap analysis, Illinois, Indiana, Ohio, Wisconsin, Michigan

In the past, faunal studies and alpha-taxonomic work played a significant role in biological research. Their importance and influence in biological science diminished during the past 6 decades (Wheeler 2004), especially in the developed (and supposedly well-studied) regions in the world, such as Europe and North America. The recent focus on biodiversity decline and conservation efforts demonstrates significant gaps in our faunistic knowledge. While species discovery for vertebrates is well advanced, the discovery of the majority of non-vertebrate species on the planet (Agenda 2000) lags far behind (Knapp et al. 2005). A 139% increase of recorded bivalve species from the Florida Keys between 1995 and 2004 illustrates the point (Bieler & Mikkelsen 2004).

Conservation efforts focus mainly on the estimated species-richness of habitats and the occurrence of endangered and threatened species (Mace 2004). Charismatic vertebrate species and their protection are most often invoked in conservation actions, whereas the majority of animal biodiversity, the invertebrates, remains on the sideline. We often know so little about species' ranges and abundance that species-richness estimates for any particular habitat or region are vague and uncertain.

Spiders, a mega-diverse group with 38,000 described species (Platnick 2005) are a case in point. As insect predators, they play a pivotal role in the regulation of insect populations in all terrestrial habitats. Species lists offer solid baseline data for large-scale biogeographic analyses, survey and monitoring efforts, and tracking of environmental changes. These lists form the foundation of species-richness estimates. Yet, reliable, up-to-date spider species lists for the 50 United States are not available, because faunistic research declined (and lost funding) before the job was done (Crawford 1988). Consequently, the current assemblage of spider species lists suffers from several problems, impeding biogeographic research as well as hampering their utility for ecological research and conservation efforts.

Spider species lists for various states and habitats were completed over a long period of time. The species records for the five states covered here are gleaned from the literature dating back 50 years for Wisconsin (Levi & Field 1954), while Indiana and Illinois were covered recently (Beatty 2002). Species names changed during this period. While such name changes are often somewhat naively decried as hampering the accessibility of the records (Golding & Timberlake 2003), it is imperative to assert that such name changes are the result of significant and badly needed progress in the systematics of the animals involved (see for example Froese & Pauly 2005). Since invertebrates in general, and spiders in particular are species-rich and require highly trained taxon-experts for identification, more name changes can be expected in the decades to come. Authors of previous species lists used various cross-reference methods to make lists compatible by citing older names in their lists, but these in turn became quickly out-dated. Therefore, employing such lists for various research and conservation tasks requires significant taxon-expertise and general users, especially within the ecological research and conservation communities, still face obstacles interpreting and using these records (Gotelli 2004).

Traditional forms of printed publications of individual species lists hamper regional and inter-state comparisons of species records. In connection with the significant time-gap between individual faunal lists and the inevitable nomenclatorial changes, such species lists do not support biogeographic research (Soberón & Peterson 2004), nor do they offer easy access to species-richness estimates. There are currently numerous activities with respect to GIS software development (e.g., Lifemapper, http://Lifemapper.org) to generate distribution maps. The goal is a '. . . predictive, electronic atlas of Earth's biological diversity,' the data for which must be retrieved from '. . . records of millions of plants and animals in the world's natural history museums.' Certainly, locality data taken directly from actual collection specimens would provide the best possible foundation of species-richness estimates and biogeographic research (Graham et al. 2004). Furthermore, vouchered museum specimens can be re-examined at any time for additional data, such as sex, size, abundance, and intraspecific variability; misidentifications will be rooted out over time. What stands between us and such a rich data source is the simple fact that the data of most invertebrate, especially arthropod collections, have not been electronically captured, and, at the current meager state of collection support, we cannot expect access to these data any time soon.

What measures, then, can be taken now to accelerate the rate of biodiversity discovery, either through sampling in nature or mining of museum collections? The existing faunistic and taxonomic literature harbors a wealth of biogeographic data; making these legacy data universally available, i.e., electronically and nomenclatorially updated, will serve a wide range of users, from researchers to land managers to collection managers. Various taxonomic authority files can be generated from such cross-referenced legacy data, e.g., generating species lists for states, regions, or habitats, aiding in museum collection management, and guiding future survey and monitoring efforts. The present study clearly demonstrates the great utility and predictive power of old-fashioned faunistics required for today's biodiversity research.

Our approach.—Two of the prevailing problems inherent to traditional faunal lists are the nomenclatorial changes due to time gaps and the isolation of lists from one another, hampering comparison and predictions. Using modern database technologies and electronic dissemination over the Web (Scoble 2004), these problems can be easily overcome today. However, even with these technologies, keeping checklists and nomenclature up-to-date requires expertise by sufficiently supported taxon-specialists. Spider systematics benefited from a relatively large number of active spider systematists, when compared to other rather neglected groups, such as many other terrestrial arthropods (e.g., the Myriapoda, see Milli-PEET, Field Museum Website). Furthermore, spider systematics is boosted by a rare piece of scientific infrastructure, an online world-wide taxonomic catalog (Platnick 2005). Such a catalog, generated and maintained by a taxon expert, forms the standardized base for all spider species names used here. The need for such standardization is readily acknowledged by the conservation and ecology user community (e.g., NatureServe's Central Databases, '. . . a "standard" name is selected and maintained . . .' for every '. . . taxon tracked in its database').

To track name changes we employ the *Spider Species Name Concordance Table* (Appendix II). The table contains all species names and genus-species combinations present in the referenced species lists (see Literature Cited) with their currently valid name according to Platnick (2005). Appendix II is available online at http://www.uwgb.udu/biodiversity/glspiders.

Comparisons between regions, habitats and states demonstrate differences in recorded species, allow predictions, and guide future species discovery. Explanations of recorded species differences can be sought; species-richness estimates can be deduced. Electronic manipulation of such species data allows sorting the data in various ways to answer questions about distribution and species-richness, and facilitates the discovery of faunal shifts. Recorded occurrences of species allow for prediction of future discovery of species in nearby regions (gap analysis). The species lists as presented in Table 8 and Appendices I and II are available online at http://www.uwgb.udu/biodiversity/glspiders. The data are also presented in database format at the same site. Maintaining such lists online will allow periodic updates. We hope that others will join the endeavor and add spider species lists for more U.S. states.

METHODS

The project brought together species records from a variety of sources (see Literature Cited) for five states surrounding the Great Lakes: A northern tier of two states, Wisconsin and Michigan, and a southern tier of three states, Illinois, Indiana, and Ohio (Fig. 1). Essentially the whole area of these states is part of the Great Lakes bioregion of eastern North America, which also includes portions of Minnesota, Pennsylvania, New York, and the Canadian province of Ontario. For four of the studied states, species lists exist in some form. Additional records were gleaned from regional and habitat surveys, from the alpha-taxonomic literature, and in some cases directly from identified specimens in collections.

Fig. 1.—The Great Lakes states study region, consisting of a northern tier (Wisconsin (WI) and Michigan (MI)) and a southern tier (Illinois (IL), Indiana (IN), and Ohio (OH)) of states at the center of the Great Lakes bioregion of eastern North America.

Included species records.—Inclusion of a species record followed the criterion: Is the species likely to be "established" i.e., have reproducing populations in the area? Thus, exotic species are listed, as are species that live only in buildings, as long as it is reasonable to assume that they actually reproduce in the Great Lakes region. Casual importations, such as exotic tarantula species in the houses of pet owners are excluded from the list. Certain exotic species, such as the huntsman spider *Heteropoda venatoria*, are occasionally imported with lumber and other merchandise and are encountered by the public as repeated inquiries to the authors indicate. Such species records are discussed in the text, but are not included in the spider species list of the Great Lakes States (Table 8 and Appendix I). Species records of a non-established species that appear in the published literature are listed in the Spider Species Name Concordance Table (Appendix II). If intercepted guest spiders are known only from informal records and public inquiries, such species are discussed in the text. Uncertainties remain, such as the brown recluse spider (*Loxosceles reclusa*), which is native to southern Illinois, but reproducing populations have occasionally been encountered in some buildings in the region north of the species' natural range. Such species are included in the Great Lakes States spider species list. We further scrutinized the published spider species lists for questionable species records, mainly Palearctic species recorded for the Midwestern U.S. states. In each case a decision was based on the best of our knowledge whether the species was likely to have established populations in the Great Lakes area. Published records of clearly Palearctic species or species suspected to be misidentifications are not included in Table 8 and Appendix I, but can be found in the Spider Species Name Concordance Table (Appendix II) and are discussed in the text. It should be noted here that current geographic ranges of species, as they are noted in the Worldwide Spider Catalog (Platnick 2005), do not necessarily reflect the biogeographic origin of a species. Thus, a species listed as Holarctic may very well be introduced to a part of the Holarctic range. Several such cases are discussed below, and their biogeographic labels in Table 8 reflect our evaluation of their biogeographic status.

Compilation of species lists.—Spider species records are arranged alphabetically by family, genus, and species in Table 8 and Appendix I. Each species is found under its current genus-species combination (as listed in Platnick's on-line catalog 2005), which is not necessarily the combination used in the sources cited in Appendix I. Genera are listed in the family they are currently assigned to and disregard past family placements. Major family placement changes occurred with genera now assigned to the Agelenidae, Amaurobiidae, Liocranidae, Corinnidae, and Dictynidae. These, as well as a listing of old family names, are captured in the auxiliary Tables 6 and 7. Although we recognize that different opinions exist about genus placement or validity of species and synonyms, use of Platnick's nomenclature allows a stable foundation for all subsequent work and analyses conducted with the data presented. Table 8 lists presence-absence within states, and Appendix I lists sources and vouchers. For the literature source of the species records, a code is given, which can be found in the reference section. Name changes are dealt with in the Spider Species Name Concordance Table (Appendix II).

Illinois: The Illinois species records are taken from the faunistic and biogeographic literature (Kaston 1955; Beatty & Nelson 1976; Moulder 1966, and Beatty 2002) and a field guide (Moulder 1992). These are augmented by several sources. Spider records from the on-line database of Illinois species of the Illinois Natural History Survey (edited by S. Hill) were incorporated [URL: remains unavailable]. Also, spider material from pitfall traps and Berlese extractions in Cook and Lake Counties yielded additional records, primarily of ground spider species; these voucher specimens (Appendix I) are deposited at the Field Museum. The Cook County specimen collections were done biweekly from May to October in 1996 through 1999. Spider specimens were sorted and identified by co-author E. Lehman with additional determinations by P. Sierwald and M. Draney; the Cook county records have been databased (Field Museum of Natural History). The Lake County survey was conducted from 20 June–30 August, and 20, 24, 29 September 1999. Spider specimens were sorted and identified by co-author T. Prentice. The specimens are deposited at the Field Museum. We integrated the data of all vouchers from the five states housed in the collections of the Illinois Natural History Survey (University of Illinois, Champaign-Urbana) into our database (courtesy of C. Farvet); the majority of the INHS collection's spider specimens are from Illinois. The Illinois State Museum in Springfield (Illinois) maintains an on-line spider species database, which provides data on vouchered county records. Currently (2005) the Illinois State Museum database contains 224 spider species for Illinois. All vouchered species for which county records are cited are included in the Illinois species list.

Indiana and Ohio: The species records for Indiana are based on the most recent checklist by Beatty (2002, which incorporates the list by Parker 1969). The Ohio species records are adopted from an on-line state species list generated by Dr. Richard Bradley (Ohio State University, permission for inclusion granted) based on published records and voucher specimens of spider species from Ohio. No additional sources were drawn on for these two states.

Michigan: The Michigan data, initially compiled by Joan Jass (Curator of Invertebrates, Milwaukee Public Museum), are based on faunal studies of particular areas (Drew 1967; Chickering 1932, 1933, 1934), faunal studies restricted to particular habitats (Brady et al. 1991), and taxon-specific faunal lists by Chickering (1939, 1940, 1944, 1959) and Wolff (1984). Again, the alpha-taxonomic literature provided additional species records (Platnick & Dondale 1992; Proszynski 1968). Various statewide spider species lists were produced by Chickering & Bacorn (1933), Chickering (1935) and most recently by Snider (1991).

Wisconsin: The Wisconsin data compiled initially by Joan Jass (Milwaukee Public Museum) are based on state faunal lists (Levi & Field 1954; Levi et al. 1958), regional surveys (Blaczyk et al. 1992), habitat surveys (LeSar & Unzicker 1978; Riechert & Reeder 1978) and the taxonomic literature of Dondale & Redner (1976, 1978, 1982, 1990) and Levi (1980). Species records and vouchers (Appendix I) were added from identified and computerized collections at the Milwaukee Public Museum.

Spider species name concordance table (Appendix II).—Numerous name changes have occurred in North American spiders during the almost 70 years since publication of the earliest of the literature sources drawn upon. In some cases, a single species may have been renamed several times as a result of synonymies and taxonomic revisions. Some species were originally misidentified until later taxonomic work clarified species identities. Some species were transferred to other genera; other names were synonymized. Such name changes are captured in Appendix II. The table lists genus and species names as they occurred in each of the literature sources listed (see Appendix I) for that species. Historical intermediary names not used in the faunal source lists are not included. Thus "*Epeira cornuta* Clerck 1757" and "*Araneus cornutus* (Clerck 1757)" would both indicate "transferred to *Larinioides*," the current araneid genus. *Example, species transferred to a different genus:* The Illinois Natural History Survey database (INHSD) listed the amaurobiid species: *Coelotes juvenilis* Keyserling. We added year of first description according to Platnick to ensure an unambiguous identification. The species is currently assigned to the genus *Coras*. Appendix I lists "*Coras juvenilis* (Keyserling 1881)" giving INHSD as a source, and indicates that it has also been recorded from Indiana, Michigan and Ohio, but not Wisconsin. Appendix II lists *Coelotes juvenilis*, the literature source (INHSD) and the current name *Coras juvenilis* in the last column.

Table 8 and Appendix I list the currently valid genus-species name combination, crediting the source, even if the source listed this species under what is now considered a junior synonym. *Example, synonyms in faunal source lists:* In 1933, Chickering and Bacorn added *Anyphaena rubra* to the known Michigan Anyphaenidae. *Anyphaena rubra* was determined to be a junior synonym of *Hibana gracilis*. Table 8 lists *Hibana gracilis* as a member of the Michigan fauna. Appendix I credits 'c&b' as a source for the *Hibana gracilis* (Hentz 1847) record in Michigan, although they originally listed the species as *Anyphaena rubra*. Appendix II notes this species synonymy. Minor typographical errors and discrepancies, such as the year of publication, and grammatically incorrect endings of species names (e.g., *-us* versus *-a*) are not included in Appendix II.

Statistical analysis.—Since this compilation represents "meta data" compiled from numerous sources and representing records originally amassed using various methodologies and for various purposes, no rigorous statistical analyses comparing richness or diversity among states were attempted. However, we did explore correlations of number of taxa that are now known from each state, with various basic properties of those states, including land area, population, and date that the state entered the union (as an index of how long the state has been intensively occupied by non-indigenous settlers). Properties of the states were obtained from the U.S. Census Bureau (2004). Relationships were explored using Pearson Correlation Coefficients (Systat 10, Systat, Inc., Evanston, IL). We also ran Chi-square tests to compare the number of species within each family with the region-wide average species-richness of each family, using Microsoft Excel. This was done to determine whether the composition of each state's species assemblage differed from the entire region's assemblage.

RESULTS

Species-richness analysis.—To date, 900 spider species have been recorded from the

Table 1.—List of top 20 most speciose genera in the region of the Great Lakes states.

Rank	Family	Genus	Species in region
1	Thomisidae	*Xysticus*	25
2	Clubionidae	*Clubiona*	23
2	Philodromidae	*Philodromus*	23
4	Araneidae	*Araneus*	21
5	Linyphiidae	*Walckenaeria*	19
6	Linyphiidae	*Ceraticelus*	17
6	Lycosidae	*Pirata*	17
6	Theridiidae	*Theridion*	17
9	Gnaphosidae	*Drassyllus*	15
10	Lycosidae	*Pardosa*	14
11	Dictynidae	*Emblyna*	13
11	Salticidae	*Phidippus*	13
13	Dictynidae	*Dictyna*	12
13	Linyphiidae	*Meioneta*	12
13	Lycosidae	*Schizocosa*	12
13	Tetragnathidae	*Tetragnatha*	12
17	Linyphiidae	*Eperigone*	11
17	Salticidae	*Habronattus*	11
17	Theridiidae	*Robertus*	11

five-state region: 646 from Illinois, 383 from Indiana, 571 from Ohio, 479 from Wisconsin and 563 from Michigan. The 900 recorded spider species represent 284 genera and 40 families (Table 2). The most speciose family in the region is Linyphiidae, with 24% of species. This is over twice the species diversity of the next most diverse families, Salticidae (10.3%), Theridiidae (8.9%), Lycosidae (8.8%), and Araneidae (7.7%). Gnaphosidae and Thomisidae also make up 5% or more of the region's species; 10 other families make up 1% or more of the region's species, and the remaining 25 families each are represented by less than 1% of the total species (Table 2). The top 8 families contain over 75% of the region's species, and the top 13 families make up over 90%. The region's most speciose genera are listed in Table 1, and include *Xysticus* (25 species) followed by *Clubiona, Philodromus,* and *Araneus,* each represented by over 20 species. The ten most speciose genera mainly consist of globally speciose genera, including the type genera of four families (*Clubiona, Philodromus, Araneus,* and *Theridion*). It is not surprising that such large genera are represented by a number of species in our region. Most of these genera are represented in our region by only 3–10% of their total known species complement. One prominent exception is *Ceraticelus*; 47% of the world's species have been recorded from our region, making it a "hotspot" for the genus. Similar arguments could perhaps be made for *Pirata* and *Drassyllus* (our region includes 19% and 17% of the world's known species, respectively).

The number of species in each state varies from Indiana's 383 (42.5% of the region's total) to Illinois' 646 (71.7% of the region's total; Table 2). This shows that latitude and longitude do not predict the size of the current state lists, since the states with the highest and lowest numbers are both in the region's southern tier, and in fact are adjacent. Pearson correlation (Using Systat 10; Tables 3 and 4) shows that the number of species in each state is only weakly correlated with land area (0.609), but strongly correlated with the state's 2000 U.S. Census population (0.897). This supports our suggestion that the region's fauna is very incompletely known, and hence the size of the list is determined more by sampling effort (which has generally been higher in more populated states) than with biological or geographic differences between the states.

The number of families recorded from each state varied from 29 in Michigan and Wisconsin (72.5% of the region's total) to 39 in Illinois and Ohio (97.5% of the region's total). There is only a weak correlation between species and families recorded in each state (Pearson coefficient = 0.506), and a negative correlation between family richness and land area (−0.311). The correlation between state population size and family richness is weaker than with species (0.715). The strongest predictor of family richness in the region is clearly latitude; all three southern tier states (Illinois, Indiana, and Ohio) have recorded 4–10 more families than the two northern tier states (Michigan and Wisconsin). This suggests that several families reach their northernmost limits within our region, and that family level richness does indeed decrease with latitude across the region.

The proportional representation of species within families (i.e., species-rich versus species-poor families) within each state roughly reflects the region-wide pattern: A few diverse families contain most of the species. Linyphiidae and Salticidae are the most and second-most diverse families in all five states, and the region's top 6 most diverse families are the top six in each state, although the order varies somewhat (Table 2). However, the proportional representation of species within families is statistically different from the region average in some states. Chi-square tests compared the number of species within each family with the average species-richness of each family for the region by scaling the species-within-family richness to match the region-wide average richness. For these tests, families with less than 1% of the region's species (families ranked 16–40) were pooled into a single "rare families" category (yielding *df* = 15). The faunal structure of Ohio, Michigan, and Wisconsin did not statistically differ from this five-state average, but Illinois' fauna was different at $P = 0.05$ and Indiana's fauna was different at $P = 0.001$. These differences may be due to historical particulars rather than reflecting biological differences. For example, Illinois' list contains proportionally more corinnid species and fewer species of the "rare families" than the region's average, whereas Indiana's list contains far fewer linyphiid and gnaphosid species and more species of the "rare families" than the region's average (Table 2). We think it is easier to explain these differences as attributable to different collection methods or different research objectives of past studies than to put forward a reasonable biological explanation for these patterns.

A total of 237 of the 900 species (26.3%) are recorded from all five of the states. Similarly, 244 species (27.1%) are known from only one of the five states. Smaller numbers of species are known from 2 to 4 states: 171 species (19%) from two states, 125 species (13.8%) from three states, and 123 species (13.6%) from four states (Table 8). This pattern is not unexpected, since many species are widespread and common, and often appear in all states surveyed, and other rarely collected species are likely to occur only once until much sampling is done.

Also not surprisingly, states with more recorded species tend to have more regionally-unique species: The most species-rich state, Illinois, had 80 regionally unique species, followed by Michigan (66), Ohio (55), Wisconsin (28), and Indiana (15). Note this is the same order as species-richness, except that Michigan and Ohio switched order.

Gap analysis.—One of the important potential uses of sets of internally consistent species lists such as we present here is to predict the occurrence of species in areas from which they have not yet been recorded. Due to the region's history of repeated glaciation (which has resulted in a relatively newly colonized fauna in a topographically subtle region), spider species tend to have large ranges and few are narrowly endemic or endemic to small areas within this region. This empirical observation lends credence to our assumption that the geographic position of the states will tend to contain information about species distribution. For example, if a species occurs in states both east and west of a given state, it probably also occurs within that state. Similarly, if a species occurs in states with similar latitudes and other states with similar longitudes as the state in question, the species is also likely to occur in the state in question. Although it is certainly possible for a species to occur in any four of the states but not in a fifth, it is also true that such occurrences would usually necessitate very specific (and seemingly improbable) geographic distribution patterns. Thus, for many state occurrence combinations, we feel that a species is much more likely to exist within some unrecorded states than not to exist there. Using this sort of logic applied to our two-tiered, five state region (Fig. 1), we examined Table 8 and predicted occurrences of species within states from which they have not yet been recorded (Table 8); 'P' in a cell indicates a species is predicted to occur in a state, using the following criteria:

1) If a species has been recorded from 4 of the 5 states, we predict it also occurs in the fifth state. There were 123 such predicted occurrences.
2) Species found in 3 states should also occur in the others, except that (a) species found only in the southern tier states (Illinois, Indiana, and Ohio) are not predicted to occur in the northern tier states (Michigan and Wisconsin); (b) species found only in the western states (Illinois, Indiana, and Wisconsin) are not predicted to occur in the eastern states (Michigan and Ohio); and (c) species found only in the eastern states (Indiana, Michigan, and Ohio) are not predicted to occur in the western states (Illinois and Wisconsin). There were 182 such predicted occurrences.

Table 2.—Spider fauna comparison of the five Great Lakes states, ordered by regional species-richness of family. Explanation of columns. G = total number of genera of the particular family represented in the region. S = total number of species of the particular family represented in the region. IL = Illinois, IN = Indiana, OH = Ohio, MI = Michigan, and WI = Wisconsin. State Columns: number of species of the particular family represented in each state. Rank = species-richness rank within the region. Cum% = cumulative percentage of spider fauna of region. Region = family species percentage in the region. IL%, IN%, OH%, MI%, and WI%: family species percentage in the respective state. Explanation of bottom rows: Total genera, species and families: for the region and by state. Regional species, regional families: percentage of the total region's species and families represented in each state.

Spider family	G	S	IL	IN	OH	MI	WI	Rank	Cum %	Region	IL%	IN%	OH%	MI%	WI%
Linyphiidae	89	217	132	56	113	124	102	1	24.1%	24.1%	20.4%	14.6%	19.9%	22.1%	21.3%
Salticidae	34	93	73	44	67	56	61	2	34.4%	10.3%	11.3%	11.5%	11.8%	10.0%	12.8%
Theridiidae	23	80	60	34	54	44	44	3	43.3%	8.9%	9.3%	8.9%	9.5%	7.8%	9.2%
Lycosidae	14	79	56	41	49	58	41	4	52.1%	8.8%	8.7%	10.7%	8.6%	10.3%	8.6%
Araneidae	22	68	54	35	54	38	39	5	59.7%	7.6%	8.4%	9.1%	9.5%	6.8%	8.2%
Gnaphosidae	16	63	48	24	40	47	34	6	66.7%	7.0%	7.4%	6.3%	7.0%	8.4%	7.1%
Thomisidae	8	45	30	23	28	34	26	7	71.7%	5.0%	4.6%	6.0%	4.9%	6.0%	5.4%
Dictynidae	7	43	26	23	24	28	22	8	76.4%	4.8%	4.0%	6.0%	4.2%	5.0%	4.6%
Corinnidae	8	34	29	12	18	16	11	9	80.2%	3.8%	4.5%	3.1%	3.2%	2.8%	2.3%
Philodromidae	4	34	25	16	16	30	21	10	84.0%	3.8%	3.9%	4.2%	2.8%	5.3%	4.4%
Clubionidae	2	24	16	7	13	17	14	11	86.7%	2.7%	2.5%	1.8%	2.3%	3.0%	2.9%
Tetragnathidae	7	23	19	16	17	17	16	12	89.2%	2.6%	2.9%	4.2%	3.0%	3.0%	3.3%
Amaurobiidae	5	12	7	7	9	11	6	13	90.6%	1.3%	1.1%	1.8%	1.6%	2.0%	1.3%
Pisauridae	2	10	10	8	8	7	5	14	91.7%	1.1%	1.5%	2.1%	1.4%	1.2%	1.0%
Anyphaenidae	4	9	9	5	6	5	4	15	92.7%	1.0%	1.4%	1.3%	1.1%	0.9%	0.8%
Agelenidae	2	8	7	4	6	6	7	16		0.9%	1.1%	1.0%	1.1%	1.1%	1.5%
Hahniidae	5	8	6	4	6	6	5	17		0.9%	0.9%	1.0%	1.1%	1.1%	1.0%
Mimetidae	2	7	4	3	6	4	5	18		0.8%	0.6%	0.8%	1.1%	0.7%	1.0%
Atypidae	1	4	3	1	3	1	1	19		0.4%	0.5%	0.3%	0.5%	0.2%	0.2%
Antrodiaetidae	2	3	2	0	2	0	0	20		0.3%	0.3%	0.0%	0.4%	0.0%	0.0%
Liocranidae	1	3	2	2	2	2	2	21		0.3%	0.3%	0.5%	0.4%	0.4%	0.4%
Miturgidae	2	3	3	1	3	1	1	22		0.3%	0.5%	0.3%	0.5%	0.2%	0.2%
Nesticidae	2	3	1	2	1	0	1	23		0.3%	0.2%	0.5%	0.2%	0.0%	0.2%
Oxyopidae	1	3	3	1	2	2	2	24		0.3%	0.5%	0.3%	0.4%	0.4%	0.4%
Uloboridae	3	3	3	3	3	2	2	25		0.3%	0.5%	0.8%	0.5%	0.4%	0.4%
Cybaeidae	2	2	1	0	1	1	0	26		0.2%	0.2%	0.0%	0.2%	0.2%	0.0%
Mysmenidae	2	2	2	0	2	0	0	27		0.2%	0.3%	0.0%	0.4%	0.0%	0.0%
Oecobiidae	1	2	1	0	2	0	0	28		0.2%	0.2%	0.0%	0.4%	0.0%	0.0%
Pholcidae	2	2	2	2	2	1	2	29		0.2%	0.3%	0.5%	0.4%	0.2%	0.4%
Sicariidae	1	2	2	1	2	0	0	30		0.2%	0.3%	0.3%	0.4%	0.0%	0.0%
Titanoecidae	1	2	2	2	2	1	1	31		0.2%	0.3%	0.5%	0.4%	0.2%	0.2%
Ctenidae	1	1	1	1	1	0	0	32		0.1%	0.2%	0.3%	0.2%	0.0%	0.0%
Ctenizidae	1	1	1	0	0	0	0	33		0.1%	0.2%	0.0%	0.0%	0.0%	0.0%

Table 2.—Continued.

Spider family	G	S	IL	IN	OH	MI	WI	Rank	Cum %	Region	IL%	IN%	OH%	MI%	WI%
Dysderidae	1	1	1	1	1	0	1	34		0.1%	0.2%	0.3%	0.2%	0.0%	0.2%
Oonopidae	1	1	1	0	1	1	0	35		0.1%	0.2%	0.0%	0.2%	0.2%	0.0%
Scytodidae	1	1	1	1	1	1	1	36		0.1%	0.2%	0.3%	0.2%	0.2%	0.2%
Segestriidae	1	1	1	1	1	0	0	37		0.1%	0.2%	0.3%	0.2%	0.0%	0.0%
Tengellidae	1	1	0	0	1	0	0	38		0.1%	0.0%	0.0%	0.2%	0.0%	0.0%
Theridiosomatidae	1	1	1	1	1	1	1	39		0.1%	0.2%	0.3%	0.2%	0.2%	0.2%
Zoridae	1	1	1	1	1	0	0	40		0.1%	0.2%	0.3%	0.2%	0.0%	0.0%
Total genera	284														
Total species		900	646	383	571	563	479			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total families		40	39	33	39	29	29								
% Regional families			97.5%	82.5%	97.5%	72.5%	72.5%								
% Regional species			71.7%	42.5%	63.2%	62.4%	53.1%								

3) We considered that species found in two states could predict occurrences in other states in certain circumstances (refer to Fig. 1). (a) Species from Illinois and Ohio should occur in Indiana. (b) Species from Illinois and Michigan should occur in Indiana. (c) Species from Indiana and Wisconsin should occur in Illinois. (d) Species from Ohio and Wisconsin should occur in the other three states.

Combinations we felt were not likely to be predictive of other state occurrences were: Illinois and Indiana; Illinois and Wisconsin; Indiana and Ohio; Indiana and Michigan; Ohio and Michigan; and Michigan and Wisconsin. There were 86 predicted occurrences using pairs of state occurrences.

Altogether, using 2642 recorded species occurrences, we predict 385 occurrences of species in states in which they are not yet recorded. If all these predictions are correct, this would increase the region's average state richness from 528 to 605 species, and raise individual state species totals by about 5% to about 53% (mean 17%, Table 5), even though the region's total species-richness would not increase with these additions. Note that the number of predicted occurrences in any one state depends both on having supposed gaps in species (inadequate sampling of a state) as well as the state's geographic position (peripheral areas benefit less than more central areas under our prediction criteria). Because of both of these factors, Indiana's fauna is predicted to increase the most using this gap analysis method; it is even predicted to have more species than Wisconsin, although this method does not predict all possible unrecorded species. Many areas (especially on the periphery of a region) may have unrecorded species that have not been recorded elsewhere in the region. Wisconsin, for example, may harbor unrecorded species that reach their southernmost limit within the state, and neither have been previously, nor in the future will be recorded in the southern tier of states. Note that we are not suggesting that predicted species do definitely occur in predicted states, only that it is more likely that they do occur there than that they do not. Until confirmed with specimens, our predictions should be considered to be hypotheses of species occurrence. Also note that failure to obtain a pre-

Table 3.—State statistics for the five Great Lakes states, comparing number of recorded spider species, land area and population. Data on land area, population, and date of statehood are from U.S. Census Bureau (2004).

State characteristics	Illinois	Indiana	Ohio	Michigan	Wisconsin
Species	646	383	571	563	479
Land area, km^2	143,963	92,896	106,055	147,122	140,673
Land area, rank	24	38	35	22	25
Entered Union	1818	1816	1803	1837	1848
Entered Union, rank	21	19	17	26	30
Population (2000 census)	12,419,293	6,080,485	11,353,140	9,938,444	5,363,675
Population, rank	5	14	7	8	18

dicted occurrence does not mean that we predict a species will not occur in a state, but only that insufficient information exists in our matrix for us to venture a prediction.

Biogeographic analysis.—The known established spider fauna of the Great Lakes States is composed mainly of native Nearctic species (some of which may possibly actually be neotropical). In addition, 85 Holarctic species (9.4% of total, Table 8, denoted by 'H' in column D), common to both Old and New World temperate regions, count as native species. When referring to non-native taxa, we are generally discussing species that are not native to North America. New state or regional records, other than for most cosmopolitan and Palearctic taxa, are likely to be the result of new collecting efforts, rather than indicating range extensions for the respective species that are native to America and, occasionally, to southern Canada and northern Mexico.

However, in cases where specimens of native taxa are found great distances from their known ranges, accidental importation is often suspected. Whether or not a species has become established must be ascertained in order to define which species are actually representative of the spider fauna of a state or region. If a non-native species generates a reproducing population then it has become an integral part of the local community, regardless of the consequences of its presence. On the other hand, particular spiders are occasionally imported with shipments of agricultural and/or ornamental plants but are unable either to reproduce or maintain viable populations in a given region; these spiders should not be included on state or regional lists.

Four species, recorded only from Ohio, were undoubtedly imported with shipments to the state and are excluded from our five-state list (see Appendix II): *Heteropoda venatoria* Linnaeus, *Cupiennius coccineus* F.O.P.-Cambridge, *Ctenus bilobatus* F.O.P.-Cambridge, and *Latrodectus hesperus* Chamberlin & Ivie. *Heteropoda venatoria* and *C. coccineus* are tropical species, the former considered pantropical, the latter naturally occurring in Costa Rica and Panama. Both species are occasionally imported to the U.S. with produce or other floral shipments but have never become established within the country (although reports suggest that *H. venatoria* has become established in Florida (e.g., Gertsch 1949, Edwards & Marshall 2001). *Ctenus bilobatus* is known from the female type from Mexico (F.O.P.-Cambridge 1900). It is most likely tropical as most of the *Ctenus* species are. If indeed the species was correctly identified, specimens were probably imported with produce shipments from Mexico. It is highly unlikely that the species would be able to establish in the

Table 4.—Pearson Correlation Matrix of state characteristics.

	Family	Species	Area	Union Date	Pop 2000
Species	0.506	1			
Area	−0.311	0.609	1		
Union date	−0.866	−0.176	0.674	−1	
Population 2000 census	0.715	0.897	0.247	−0.538	1

Table 5.—Predicted occurrences of species in states from which they are not currently recorded.

State	Recorded richness	Predicted occurrences	Predicted richness	% Change
Illinois	646	36	682	5.5%
Indiana	383	203	586	52.9%
Ohio	571	41	612	7.2%
Michigan	563	38	601	6.8%
Wisconsin	479	67	546	14.0%
Average:	528.4	77.0	605.4	17.3%
Sum:	2642	385		

north-central part of the USA. *Latrodectus hesperus* (western black widow) occurs west of the approximate mid-line through Texas, Oklahoma, and Kansas north to the Canadian provinces. This spider is also occasionally shipped with produce and other materials but there is no evidence, to date, that the species has become established in Ohio.

Non-native species: Non-native species consist of 17 cosmopolitan species (1.8% of total), seven Palearctic species (0.77% of total) inhabiting the Great Lakes region (Table 8, column D, indicated by 'C' and 'PA' respectively) and one species possibly introduced from the Pacific region and Australia (P/Au). *Tegenaria domestica* (Clerck) is an introduced cosmopolitan species in the family Agelenidae with a widespread distribution in both the Old and New Worlds. On the North American continent, it occurs at least as far north as Ellesmere Island in northern Canada (Roth 1968). The species is well established in all five of the Great Lakes states. Collection records indicate that the species is generally found in human habitations.

Three Palearctic (non-native) araneids, *Aculepeira carbonaria, Araneus triguttatus,* and *Zygiella montana* were recorded from Wis-

Table 6.—Spider genera of the Great Lakes states which were recently transferred to other families.

Genus	From	To
Agroeca Westring 1861	Clubionidae	Liocranidae
Anyphaena Sundevall 1833	Clubionidae	Anyphaenidae
Anyphaenella Bryant 1931—see *Wulfila*	Clubionidae	Anyphaenidae
Arachosia O. P.-Cambridge 1882	Clubionidae	Anyphaenidae
Aysha Keyserling 1891	Clubionidae	Anyphaenidae
Calymmaria Chamberlin & Ivie 1937	Agelenidae	Hahniidae
Castianeira Keyserling 1879	Clubionidae	Corinnidae
Cheiracanthium C. L. Koch 1839 [= *Chiracanthium*]	Clubionidae	Miturgidae
Cicurina Menge 1869	Agelenidae	Dictynidae
Coelotes Blackwall 1841	Agelenidae	Amaurobiidae
Coras Simon 1898	Agelenidae	Amaurobiidae
Cybaeopsis Strand 1907	Agelenidae	Amaurobiidae
Cybaeus L. Koch 1868	Agelenidae	Cybaeidae
Meriola Banks 1895	Clubionidae	Corinnidae
Micaria Westring 1851	Clubionidae	Gnaphosidae
Phrurolithus C. L. Koch 1839	Clubionidae	Corinnidae
Phruronellus Chamberlin 1921	Clubionidae	Corinnidae
Phrurotimpus Chamberlin & Ivie 1938	Clubionidae	Corinnidae
Scotinella Banks 1911	Clubionidae	Corinnidae
Strotarchus Simon 1888	Clubionidae	Miturgidae
Titanoeca Thorell 1869	Amaurobiidae	Titanoecidae
Trachelas L. Koch 1872	Clubionidae	Corinnidae
Wadotes Chamberlin 1925	Agelenidae	Amaurobiidae
Wulfila O. P.-Cambridge 1895	Clubionidae	Anyphaenidae

Table 7.—List of renamed spider families containing Great Lakes region species.

Previous name	Current name
Araneidae (in part)	Tetragnathidae
Argiopidae	Araneidae
Attidae	Salticidae
Clubionidae (in part)	Liocranidae
Clubionidae (in part)	Corinnidae
Clubionidae (in part)	Anyphaenidae
Drassidae	Gnaphosidae
Epeiridae	Araneidae
Erigonidae (= Micryphantidae)	Linyphiidae (in part)
Micaridae (Mikhailov & Fet 1986)	Gnaphosidae, see Platnick 2005 under Gnaphosidae
Micryphantidae (= Erigonidae)	Linyphiidae (in part)
Thomisidae (in part)	Philodromidae

consin; *Z. montana* is also reported from Michigan. The former two species are known from high elevations in the European mountains. Chamberlin & Ivie (1942) removed *Aculepeira verae* from the synonymy of *A. carbonaria* and both Levi (1951) and Levi & Field (1954) suggested that the specimen(s) collected from Wisconsin may have been *A. verae* (= *A. packardi*). Levi (1973) stated that there was no evidence that *A. triguttatus* occurs in the USA because the illustrated specimens of *Epeira mayo* (= *A. triguttatus*) were undoubtedly mislabeled. Since the original publication by Levi & Field (1954) linking these species to the Wisconsin fauna, no additional specimens have apparently been collected within the state and no voucher specimens have been located; we have removed the two species from our Great Lakes list (Appendix II). *Zygiella montana* is known from the European mountains at elevations above 1000 m. Most occurrences of the species in the USA are from mountainous areas or from northern latitudes. Voucher specimens of *Zygiella montana* are found at Michigan State University Entomological collection and in the Milwaukee Public Museum in Wisconsin. The species is also reported from Maine, North Carolina, and the Adirondacks and White Mountains. There seems to be little doubt that *Z. montana* is established in both Michigan and Wisconsin (Table 8, Appendix I). Two additional Palearctic araneid species, *Araniella cucurbitina* Clerck and *Araneus angulatus* Clerck, are reported only from Michigan; there are no known voucher specimens of either species. Snider (1991) notes that the former species is probably *A. displicata* (Hentz); and Levi (1971), in his revision of the *diadematus* Group, stated that no specimens of *angulatus* were in collections coming from North America and that the literature records of *angulatus* referred to large specimens of various other native species (Appendix II). In light of the above, we have considered these records doubtful and have excluded the species from our list of the Great Lakes spider fauna. *Larinioides sclopetarius* (Clerck) is listed as Holarctic in Platnick (2005), but Levi (1974) judges it to be introduced into North America by its anthropochorous habitats here. It should be noted that since Levi's (1974) publication, the species seems to have become much more abundant in the Great Lakes region (Table 8 and M. Draney, unpubl. observ.). It is widely distributed in Eurasia (Levi 1974).

The Banded Argiope, *Argiope trifasciata,* is considered a cosmopolitan species although it is found in many non-disturbed areas throughout the USA. According to Levi (1968), the distribution of the species is not known but is nearly worldwide exclusive of regions occupied by the Eurasian species, *A. bruennichi.* Populations of *A. trifasciata* thrive in the five-state Great Lakes region. *Gea heptagon* may be an introduced species, possibly from the Pacific region or Australia (Levi, 2004).

The cosmopolitan wood-louse (Order Isopoda) specialist, *Dysdera crocata* C. L. Koch is widely distributed within the U.S. The species thrives in the more mesic habitats where there is an ample supply of isopods (most of which are also exotic according to Jass & Klausmeier 2000). To date, it is the only *Dysdera* species known from the U.S. Well-estab-

Table 8.—Spider fauna in five Great Lakes states, species occurrence by state. Year: gives the year of first description. The state columns (IL = Illinois, IN = Indiana, OH = Ohio, WI = Wisconsin, MI = Michigan) note the absence or presence of the species in that state. 'P' in cells in state columns indicates predicted occurrences of species in those states, based on the presence of the species in other states, see text (Gap analysis); '?' indicates uncertain records. The column 'S' gives the number of states from which the species is recorded. The last column, 'D' notes the distribution or biogeographic origin of species: Cosmopolitan (C), Holarctic (H), introduced (P/Au), Palearctic (PA), Asian (A); and possible misidentifications (M?).

Species	IL	IN	OH	WI	MI	S	D
Agelenidae							
Agelenopsis emertoni Chamberlin & Ivie 1935	1	P	1	1	1	4	
Agelenopsis kastoni Chamberlin & Ivie 1941	1	P	1			2	
Agelenopsis naevia (Walckenaer 1842)	1	1	1	1	1	5	
Agelenopsis oklahoma (Gertsch 1936)				1		1	
Agelenopsis pennsylvanica (C. L. Koch 1843)	1	1	1	1	1	5	
Agelenopsis potteri (Blackwall 1846)	1	P	P	1	1	3	
Agelenopsis utahana (Chamberlin & Ivie 1933)	1	1	1	1	1	5	
Tegenaria domestica (Clerck 1757)	1	1	1	1	1	5	C
Amaurobiidae							
Amaurobius borealis Emerton 1909				1	1	2	
Amaurobius ferox (Walckenaer 1830)	1	1	1	1	1	5	H
Callobius bennetti (Blackwall 1846)	1	1	1	1	1	5	
Coras juvenilis (Keyserling 1881)	1	1	1	P	1	4	
Coras lamellosus (Keyserling 1887)	1	1	1	1	1	5	
Coras medicinalis (Hentz 1821)	1	1	1	P	1	4	
Coras montanus (Emerton 1890)	P	P	1	1	1	3	
Coras taugynus Chamberlin 1925	1					1	
Cybaeopsis tibialis (Emerton 1888)			1		1	2	
Wadotes calcaratus (Keyserling 1887)	1	1	1	1	1	5	
Wadotes hybridus (Emerton 1890)		1	1		1	3	
Wadotes tennesseensis Gertsch 1936					1	1	
Antrodiaetidae							
Antrodiaetus robustus (Simon 1891)			1			1	
Antrodiaetus unicolor (Hentz 1842)	1	P	1			2	
Atypoides hadros Coyle 1968	1					1	?
Anyphaenidae							
Anyphaena celer (Hentz 1847)	1	1	1	1	1	5	
Anyphaena fraterna (Banks 1896)	1	1	1			3	
Anyphaena maculata (Banks 1896)	1					1	
Anyphaena pectorosa L. Koch 1866	1	1	1	1	1	5	
Arachosia cubana (Banks 1909)	1	P	1	P	1	3	
Hibana cambridgei (Bryant 1931)	1					1	
Hibana gracilis (Hentz 1847)	1	1	1	1	1	5	
Wulfila albens (Hentz 1847)	1					1	
Wulfila saltabundus (Hentz 1847)	1	1	1	1	1	5	
Araneidae							
Acacesia hamata (Hentz 1847)	1	1	1	P	1	4	
Acanthepeira cherokee Levi 1976	1					1	
Acanthepeira marion Levi 1976	1					1	
Acanthepeira stellata (Walckenaer 1805)	1	1	1	1	1	5	
Araneus alboventris (Emerton 1884)			1			1	
Araneus bicentenarius (McCook 1888)	1	1		1	1	4	
Araneus bonsallae (McCook 1894)	1					1	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Araneus cavaticus (Keyserling 1882)	P	P	1	1	1	3	
Araneus cingulatus (Walckenaer 1842)	1	P	1			2	
Araneus corticarius (Emerton 1884)	P	1	P	1	1	3	
Araneus diadematus Clerck 1757	P	P	1	1	1	3	H
Araneus gemmoides Chamberlin & Ivie 1935	1			1		2	
Araneus guttulatus (Walckenaer 1842)	1			1	1	3	
Araneus iviei (Archer 1951)					1	1	
Araneus juniperi (Emerton 1884)	1	P	1			2	
Araneus marmoreus Clerck 1757	1	1	1	1	1	5	H
Araneus miniatus (Walckenaer 1842)			1			1	
Araneus niveus (Hentz 1847)	1	P	1			2	
Araneus nordmanni (Thorell 1870)	P	P	1	1	1	3	H
Araneus partitus (Walckenaer 1842)	1	P	1			2	
Araneus pegnia (Walckenaer 1842)	1	1	1	P	1	4	
Araneus pratensis (Emerton 1884)	1	1	1	1	1	5	
Araneus saevus (L. Koch 1872)	1	P	1	1	1	4	H
Araneus thaddeus (Hentz 1847)	1	1	1	1	1	5	
Araneus trifolium (Hentz 1847)	1	1	1	1	1	5	
Araniella displicata (Hentz 1847)	1	1	1	1	1	5	H
Argiope aurantia Lucas 1833	1	1	1	1	1	5	
Argiope trifasciata (Forskål 1775)	1	1	1	1	1	5	C
Cercidia prominens (Westring 1851)	1	P	1	1	1	4	H
Cyclosa conica (Pallas 1772)	1	P	1	1	1	4	H
Cyclosa turbinata (Walckenaer 1842)	1	1	1	1	1	5	
Eustala anastera (Walckenaer 1842)	1	1	1	1	1	5	
Eustala cepina (Walckenaer 1842)	1	1	1	1	1	5	
Eustala emertoni (Banks 1904)	1	P	1			2	
Gea heptagon (Hentz 1850)	1	P	1	P	1	3	P/Au
Hypsosinga funebris (Keyserling 1892)	1	P	1			2	
Hypsosinga pygmaea (Sundevall 1831)	1	1	1	1	1	5	H
Hypsosinga rubens (Hentz 1847)	1	1	1	P	1	4	
Larinia borealis Banks 1894	1	P	1	1	1	4	
Larinia directa (Hentz 1847)			1			1	
Larinioides cornutus (Clerck 1757)	1	1	1	1	1	5	H
Larinioides patagiatus (Clerck 1757)	1	1	1	1	1	5	H
Larinioides sclopetarius (Clerck 1757)	1	1	1	1	1	5	PA
Mangora gibberosa (Hentz 1847)	1	1	1	1	1	5	
Mangora maculata (Keyserling 1865)	1	1	1	P	1	4	
Mangora placida (Hentz 1847)	1	1	1	1	1	5	
Mastophora bisaccata (Emerton 1884)	1	1	1	P	1	4	
Mastophora cornigera (Hentz 1850)		1				1	
Mastophora hutchinsoni Gertsch 1955	1	1	1			3	
Mastophora phrynosoma Gertsch 1955	1					1	
Metazygia calix (Walckenaer 1842)	1	P	1			2	
Metepeira labyrinthea (Hentz 1847)	1	1	1	1	1	5	
Metepeira palustris Chamberlin & Ivie 1942				1		1	
Micrathena gracilis (Walckenaer 1805)	1	1	1	1	1	5	
Micrathena mitrata (Hentz 1850)	1	1	1	1	P	4	
Micrathena sagittata (Walckenaer 1842)	1	1	1	1	1	5	
Neoscona arabesca (Walckenaer 1842)	1	1	1	1	1	5	
Neoscona crucifera (Lucas 1839)	1	1	1	1	1	5	
Neoscona domiciliorum (Hentz 1847)	1	1	1	1	P	4	
Neoscona oaxacensis (Keyserling 1864)		1				1	
Neoscona pratensis (Hentz 1847)	1	1	1	1	1	5	
Ocrepeira ectypa (Walckenaer 1842)	1	P	1			2	
Ocrepeira georgia (Levi 1976)			1			1	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Singa eugeni Levi 1972	1	P	1	1	1	4	
Singa keyserlingi McCook 1894	1	P	1	1	P	3	
Verrucosa arenata (Walckenaer 1842)	1	1	1	1	P	4	
Zygiella montana (C. L. Koch 1834)				1	1	2	PA
Zygiella nearctica Gertsch 1964					1	1	H
Atypidae							
Sphodros atlanticus Gertsch & Platnick 1980	1					1	
Sphodros coylei Gertsch & Platnick 1980			1			1	
Sphodros niger (Hentz 1842)	1	1	1	1	P	4	
Sphodros rufipes (Latreille 1829)	1	P	1	P	1	3	
Clubionidae							
Clubiona abboti L. Koch 1866	1	1	1	1	1	5	
Clubiona bishopi Edwards 1958	1					1	
Clubiona bryantae Gertsch 1941	1	P			1	2	
Clubiona canadensis Emerton 1890	P	P	1	1	1	3	
Clubiona catawba Gertsch 1941	1	P	1	P	1	3	
Clubiona chippewa Gertsch 1941				1	1	2	
Clubiona johnsoni Gertsch 1941	1	P	1	1	1	4	
Clubiona kastoni Gertsch 1941	1	P	1	1	1	4	
Clubiona kiowa Gertsch 1941					1	1	
Clubiona kulczynskii Lessert 1905					1	1	H
Clubiona maritima L. Koch 1867	1	1	1	1	1	5	
Clubiona mixta Emerton 1890	1	P	1	1	1	4	
Clubiona moesta Banks 1896	1	P	P	1	1	3	
Clubiona norvegica Strand 1900	1					1	H
Clubiona obesa Hentz 1847	1	1	1	1	1	5	
Clubiona pikei Gertsch 1841	1	P	1			2	
Clubiona pygmaea Banks 1892	1	1	1	1	1	5	
Clubiona quebecana Dondale & Redner 1976				1		1	
Clubiona rileyi Gertsch 1941		1				1	
Clubiona riparia L. Koch 1866	1	1	1	1	1	5	
Clubiona saltitans Emerton 1919	1					1	
Clubiona spiralis Emerton 1909			1			1	
Clubiona trivialis C. L. Koch 1843				1	1	2	H
Elaver excepta (L. Koch 1866)	1	1	1	1	1	5	
Corinnidae							
Castianeira alata Muma 1945	1					1	
Castianeira amoena (C. L. Koch 1841)	1					1	
Castianeira cingulata (C. L. Koch 1841)	1	1	1	1	1	5	
Castianeira crocata (Hentz 1847)	1	1				2	
Castianeira descripta (Hentz 1847)	1	1	1	1	1	5	
Castianeira gertschi Kaston 1945	1	P	1	P	1	3	
Castianeira longipalpa (Hentz 1847)	1	1	1	1	1	5	
Castianeira trilineata (Hentz 1847)	1	1	1	1	1	5	
Castianeira variata Gertsch 1942	1	P	1	P	1	3	
Meriola decepta Banks 1895	1	1	1	P	1	4	
Myrmecotypus lineatus (Emerton 1909)					1	1	
Phrurolithus concisus Gertsch 1941			1			1	
Phrurolithus emertoni (Gertsch 1935)	1					1	
Phrurolithus goodnighti (Muma 1945)	1					1	
Phrurolithus similis Banks 1895	1	1	P	P	1	3	
Phruronellus formica (Banks 1895)	1					1	
Phruronellus formidabilis Chamberlin & Gertsch 1930					1	1	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Phrurotimpus alarius (Hentz 1847)	1	1	1	1	1	5	
Phrurotimpus borealis (Emerton 1911)	1	1	1	1	1	5	
Phrurotimpus certus Gertsch 1941	1					1	
Phrurotimpus dulcineus Gertsch 1941	1					1	
Phrurotimpus illudens Gertsch 1941	1					1	
Phrurotimpus minutus (Banks 1892)	1	1	1	1	P	4	
Scotinella britcheri (Petrunkevitch 1910)	1	1	1			3	
Scotinella brittoni (Gertsch 1941)	1	P	1	P	1	3	
Scotinella deleta (Gertsch 1941)	1					1	
Scotinella divesta (Gertsch 1941)	1	P			1	2	
Scotinella fratrella (Gertsch 1935)	1	P	1			2	
Scotinella madisonia Levi 1951	1	P	1	1	P	3	
Scotinella manitou Levi 1951				1		1	
Scotinella minnetonka (Chamberlin & Ivie 1930)				1		1	
Scotinella pugnata (Emerton 1890)	1	P	1	P	1	3	
Scotinella redempta (Gertsch 1941)	1	P	1			2	
Trachelas tranquillus (Hentz 1847)	1	1	1	1	1	5	
Ctenidae							
Anahita punctulata (Hentz 1844)	1	1	1			3	
Ctenizidae							
Ummidia tuobita (Chamberlin 1917)	1	?				1	
Cybaeidae							
Cybaeota calcarata (Emerton 1911)					1	1	
Cybaeus giganteus Banks 1892	1	P	1			2	
Dictynidae							
Argenna obesa Emerton 1911	1	P	1	1	P	3	
Cicurina arcuata Keyserling 1887	1	1	1	1	1	5	
Cicurina brevis (Emerton 1890)	1	1	1	1	1	5	
Cicurina cavealis Bishop & Crosby 1926	1	1				2	
Cicurina itasca (Chamberlin & Ivie 1940)				1		1	
Cicurina ludoviciana Simon 1889	1	1				2	
Cicurina minima Chamberlin & Ivie 1940	1	1				2	
Cicurina minnesota Chamberlin & Ivie 1940	1	1	P	P	1	3	
Cicurina pallida Keyserling 1887	1	1	1	P	1	4	
Cicurina placida Banks 1892	1	1	P	1	1	4	
Cicurina robusta Simon 1886	1	1	1	1	1	5	
Dictyna arundinacea (Linnaeus 1758)					1	1	H
Dictyna bellans Chamberlin 1919	1	P	1	P	1	3	
Dictyna bostoniensis Emerton 1888	1	1	1	1	1	5	
Dictyna brevitarsa Emerton 1915			1		1	2	
Dictyna coloradensis Chamberlin 1919	1	1	P	1	1	4	
Dictyna foliacea (Hentz 1850)	1	1	1	1	1	5	
Dictyna formidolosa Gertsch & Ivie 1936	1	1	1			3	
Dictyna longispina Emerton 1888	1	P	1	1	P	3	
Dictyna minuta Emerton 1888	1	1	1	1	1	5	
Dictyna sancta Gertsch 1946				1	1	2	
Dictyna terrestris Emerton 1911					1	1	
Dictyna volucripes Keyserling 1881	1	1	1	1	1	5	
Emblyna altamira (Chamberlin & Gertsch 1958)					1	1	
Emblyna angulata (Emerton 1915)	1	1				2	
Emblyna annulipes (Blackwall 1846)	1	1	1	1	1	5	H
Emblyna consulta (Gertsch & Ivie 1936)					1	1	
Emblyna cruciata (Emerton 1888)	1	1	1	1	1	5	
Emblyna decaprini (Kaston 1945)			1			1	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Emblyna hentzi (Kaston 1945)	1	P	1	1	1	4	
Emblyna manitoba (Ivie 1947)	1			1		2	
Emblyna maxima (Banks 1892)					1	1	
Emblyna phylax (Gertsch & Ivie 1936)				1		1	
Emblyna roscida (Hentz 1850)			1		1	2	
Emblyna sublata (Hentz 1850)	1	1	1	1	1	5	
Emblyna zaba (Barrows & Ivie 1942)			1			1	
Iviella ohioensis (Chamberlin & Ivie 1935)			1			1	
Lathys foxi (Marx 1891)	P	1	1	1	1	4	
Lathys immaculata Chamberlin & Ivie 1944	1					1	
Lathys maculina Gertsch 1946		1				1	
Lathys pallida (Marx 1891)	P	1	1	1	1	4	
Phantyna bicornis Emerton 1915	1	1	1	1	1	5	
Phantyna pixi (Chamberlin & Gertsch 1958)					1	1	
Dysderidae							
Dysdera crocata C. L. Koch 1838	1	1	1	1	P	4	C
Gnaphosidae							
Callilepis imbecilla (Keyserling 1887)	1	1	1	1	1	5	
Callilepis pluto Banks 1896	1	P	1	1	1	4	
Cesonia bilineata (Hentz 1847)	1	1	1	1	1	5	
Drassodes auriculoides Barrows 1919	P	P	1	1	1	3	
Drassodes gosiutus Chamberlin 1919			1		1	2	
Drassodes neglectus (Keyserling 1887)	1	1	P	1	1	4	H
Drassodes saccatus Emerton 1889	1	P			1	2	
Drassyllus aprilinus (Banks 1904)	1	1	1		1	4	
Drassyllus covensis Exline 1962	1					1	
Drassyllus creolus Chamberlin & Gertsch 1940	1	1	1	P	1	4	
Drassyllus depressus (Emerton 1890)	1	1	1	1	1	5	
Drassyllus dixinus Chamberlin 1922	1					1	
Drassyllus eremitus Chamberlin 1922	1	P	1	1	1	4	
Drassyllus eremophilus Chamberlin & Gertsch 1940					1	1	
Drassyllus fallens Chamberlin 1922	1	P	1	1	1	4	
Drassyllus frigidus (Banks 1892)	1	P	1	P	1	3	
Drassyllus gynosaphes Chamberlin 1936					1	1	
Drassyllus lepidus (Banks 1899)	1					1	
Drassyllus nannellus Chamberlin & Gertsch 1940			1			1	
Drassyllus niger (Banks 1896)	1	P	P	1	1	3	
Drassyllus novus Banks 1895	1	1	1	1	1	5	
Drassyllus rufulus (Banks 1892)	1	1	1	1	1	5	
Gnaphosa brumalis Thorell 1875					1	1	
Gnaphosa fontinalis Keyserling 1887	1	P	1	1	P	3	
Gnaphosa muscorum (L. Koch 1866)				1	1	2	H
Gnaphosa parvula Banks 1896	1	1	1	1	1	5	
Gnaphosa sericata (L. Koch 1866)	1	1	1	1	1	5	
Haplodrassus bicornis (Emerton 1909)	1	1	1	1	1	5	
Haplodrassus hiemalis (Emerton 1909)	1	P	1	1	1	4	H
Haplodrassus mimus Chamberlin 1922	1					1	
Haplodrassus signifer (C. L. Koch 1839)	1	1	1	1	1	5	H
Herpyllus ecclesiasticus Hentz 1832	1	1	1	1	1	5	
Litopyllus temporarius Chamberlin 1922	1	1	1	P	1	4	
Micaria elizabethae Gertsch 1942	1	1	1	P	1	4	
Micaria emertoni Gertsch 1935					1	1	
Micaria gertschi Barrows & Ivie 1942	1	P	1	P	1	3	
Micaria laticeps Emerton 1909	1	P			1	2	
Micaria longipes Emerton 1890	1	P	1	1	1	4	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Micaria longispina Emerton 1911				1	1	2	
Micaria pulicaria (Sundevall 1831)	1	P	1	1	1	4	H
Micaria riggsi Gertsch 1942	1	P	1	1	1	4	
Nodocion floridanus (Banks 1896)	P	1		1		2	
Sergiolus bicolor Banks 1900			1		1	2	
Sergiolus capulatus (Walckenaer 1837)	1	1	1	1	1	5	
Sergiolus decoratus Kaston 1945	1	P	1	P	1	3	
Sergiolus lowelli Chamberlin & Woodbury 1929			1			1	
Sergiolus minutus (Banks 1898)	1			1		2	
Sergiolus montanus (Emerton 1890)	1	1	1	1	1	5	
Sergiolus ocellatus (Walckenaer 1837)	1	P	1	1	1	4	
Sergiolus tennesseensis Chamberlin 1922	1	1	P	P	1	3	
Sergiolus unimaculatus Emerton 1915					1	1	
Sosticus insularis (Banks 1895)	1	1	1	1	1	5	
Sosticus loricatus (L. Koch 1866)	1			1		2	H
Synaphosus paludis (Chamberlin & Gertsch 1940)	1					1	
Talanites echinus (Chamberlin 1922)			1			1	
Talanites exlineae (Platnick & Shadab 1976)	1					1	
Urozelotes rusticus (L. Koch 1872)	1	P	1	1	P	3	C
Zelotes duplex Chamberlin 1922	1	1	1	P	1	4	
Zelotes exiguoides Platnick & Shadab 1983	1					1	
Zelotes fratris Chamberlin 1920	1	1	1	1	1	5	H
Zelotes hentzi Barrows 1945	1	1	1	1	1	5	
Zelotes laccus (Barrows 1919)	1	1	1			3	
Zelotes puritanus Chamberlin 1922				1	1	2	H
Hahniidae							
Antistea brunnea (Emerton 1909)	1	P	P	1	1	3	
Calymmaria cavicola (Banks 1896)	1	1	1			3	
Cryphoeca montana Emerton 1909			1		1	2	
Hahnia cinerea Emerton 1889	1	1	1	1	1	5	
Hahnia flaviceps Emerton 1913	1	P	1			2	
Neoantistea agilis (Keyserling 1887)	1	1	1	1	1	5	
Neoantistea magna (Keyserling 1887)	1	1	1	1	1	5	
Neoantistea riparia (Keyserling 1887)				1	1	2	
Linyphiidae							
Agyneta olivacea (Emerton 1882)					1	1	H
Allomengea dentisetis (Grube 1861)				1		1	H
Baryphyma longitarsum (Emerton 1882)				1	1	2	
Baryphyma trifrons affine (Schenkel 1930)			1			1	H
Bathyphantes alboventris (Banks 1892)	1	P	1	1	P	3	
Bathyphantes brevis (Emerton 1911)	P	P	1	1	1	3	
Bathyphantes canadensis (Emerton 1882)			1			1	
Bathyphantes pallidus (Banks 1892)	1	1	1	1	1	5	
Bathyphantes weyeri (Emerton 1875)	P	1	1	1	P	3	
Blestia sarcocuon (Crosby & Bishop 1927)			1			1	
Centromerus cornupalpis (O. P.-Cambridge 1875)	1	1	1	1	1	5	
Centromerus denticulatus (Emerton 1909)					1	1	
Centromerus latidens (Emerton 1882)	1	1	1	P	1	4	
Centromerus longibulbus (Emerton 1882)					1	1	
Centromerus persolutus (O. P.-Cambridge 1875)				1	1	2	
Centromerus sylvaticus (Blackwall 1841)	1	P	1	1	1	4	H
Centromerus tennapex (Barrows 1940)			1			1	
Ceraticelus alticeps (Fox 1891)	1	P			1	2	
Ceraticelus atriceps (O. P.-Cambridge 1874)	1	P	1	1	1	4	
Ceraticelus bryantae Kaston 1945			1			1	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Ceraticelus bulbosus (Emerton 1882)	1	P	1	P	1	3	H
Ceraticelus carinatus (Emerton 1911)			1			1	
Ceraticelus creolus Chamberlin 1925	1					1	
Ceraticelus emertoni (O. P.-Cambridge 1874)	1	1	1	1	1	5	
Ceraticelus fissiceps (O. P.-Cambridge 1874)	1	1	1	1	1	5	
Ceraticelus laetabilis (O. P.-Cambridge 1874)	1	P	P	1	1	3	
Ceraticelus laetus (O. P.-Cambridge 1874)	1	1	P	1	1	4	
Ceraticelus laticeps (Emerton 1894)	1	P	P	1	1	3	
Ceraticelus limnologicus Crosby & Bishop 1925	1	1				2	
Ceraticelus micropalpis (Emerton 1882)	1	P			1	2	
Ceraticelus minutus (Emerton 1882)	1	1	1	1	1	5	
Ceraticelus paschalis Crosby & Bishop 1925			1			1	
Ceraticelus pygmaeus (Emerton 1882)	1	P	1	P	1	3	
Ceraticelus similis (Banks 1892)	1	P	1	1	P	3	
Ceratinella brunnea Emerton 1882	1	1	1	1	1	5	
Ceratinops annulipes (Banks 1892)	1			1		2	
Ceratinops crenatus (Emerton 1882)	1	P	1	1	1	4	
Ceratinops latus (Emerton 1882)	P	P	1	1	P	2	
Ceratinops rugosus (Emerton 1909)	1	1	1	1	P	4	
Ceratinopsidis formosa (Banks 1892)	1	P	1	1	P	3	
Ceratinopsis atolma Chamberlin 1925	1	P	1			2	
Ceratinopsis auriculata Emerton 1909	1			1		2	
Ceratinopsis interpres (O. P.-Cambridge 1874)		1	1		1	3	
Ceratinopsis laticeps Emerton 1882	1	P	1			2	
Ceratinopsis nigriceps Emerton 1882	1	P	1	1	1	4	
Ceratinopsis nigripalpis Emerton 1882	1	P	1			2	
Ceratinopsis sutoris Crosby & Bishop 1930	1					1	
Ceratinopsis xanthippe (Keyserling 1886)	1	P	1			2	
Ceratinopsis yola Chamberlin & Ivie 1939	1					1	
Cheniseo fabulosa Bishop & Crosby 1935	1					1	
Collinsia oxypaederoptipus (Crosby 1905)		1	1		1	3	
Collinsia plumosa (Emerton 1882)	1	1	1	1	1	5	
Collinsia probata (O. P.-Cambridge 1874)		1				1	
Dicymbium elongatum (Emerton 1882)			1			1	
Diplocentria bidentata (Emerton 1882)	1					1	H
Diplocephalus cristatus (Blackwall 1833)	1			1		2	H
Diplocephalus subrostratus (O. P.-Cambridge 1873)				1	1	2	H
Diplostyla concolor (Wider 1834)	1	1	1	1	1	5	H
Disembolus corneliae (Chamberlin & Ivie 1944)		1				1	
Dismodicus decemoculatus (Emerton 1882)	1	1	1	1	1	5	
Drapetisca alteranda Chamberlin 1909	P	P	1	1	1	3	
Eperigone antraea (Crosby 1926)	1					1	
Eperigone augustalis Crosby & Bishop 1933	1			1		2	
Eperigone bryantae Ivie & Barrows 1935	1					1	
Eperigone entomologica (Emerton 1911)					1	1	
Eperigone eschatologica (Crosby 1924)	1					1	
Eperigone fradeorum (Berland 1932)	1					1	C
Eperigone index (Emerton 1914)				1		1	
Eperigone maculata (Banks 1892)	1	P	1	1	1	4	
Eperigone tridentata (Emerton 1882)	1	1	1	1	1	5	
Eperigone trilobata (Emerton 1882)	1	P	1	1	1	4	H
Eperigone undulata (Emerton 1914)	1	1				2	
Epiceraticelus fluvialis Crosby & Bishop 1930			1			1	
Eridantes erigonoides (Emerton 1882)	1	1	1	1	1	5	
Eridantes utibilis Crosby & Bishop 1933	1	1	1	1	P	4	
Erigone aletris Crosby & Bishop 1928		1				1	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Erigone alsaida Crosby & Bishop 1928				1	1	2	
Erigone atra Blackwall 1833	1	1	1	1	1	5	H
Erigone autumnalis Emerton 1882	1	1	1	P	1	4	
Erigone blaesa Crosby & Bishop 1928	1	1	1	1	1	5	
Erigone dentigera O. P.-Cambridge 1874	1	1	1	1	1	5	H
Erigone infernalis Keyserling 1886	1	1				2	
Erigone praecursa Chamberlin & Ivie 1939	1					1	
Erigone zographica Crosby & Bishop 1928					1	1	
Estrandia grandaeva (Keyserling 1886)			1			1	H
Floricomus bishopi Ivie & Barrows 1935			1			1	
Floricomus plumalis (Crosby 1905)	1	P	P	1	1	3	
Floricomus rostratus (Emerton 1882)	1	P	1			2	
Florinda coccinea (Hentz 1850)	1	1	1			3	
Frontinella communis (Hentz 1850)	1	1	1	1	1	5	
Gnathonaroides pedalis (Emerton 1923)	1			1		2	
Gonatium crassipalpum Bryant 1933	1	P	1	1	1	4	
Goneatara nasutus (Barrows 1943)			1			1	
Goneatara plathyrinus Crosby & Bishop 1927	1	P	1			2	
Grammonota gentilis Banks 1898	P	P	1	1	1	3	
Grammonota gigas (Banks 1896)	1	P			1	2	
Grammonota inornata Emerton 1882	1	1	1	P	1	4	
Grammonota ornata (O. P.-Cambridge 1875)			1		1	2	
Grammonota pictilis (O. P.-Cambridge 1875)	1	P	1	1	1	4	
Grammonota vittata Barrows 1919	P	P	1	1	P	2	
Graphomoa theridioides Chamberlin 1924	1					1	
Helophora insignis (Blackwall 1841)	P	P	1	1	1	3	H
Hybauchenidium cymbadentatum (Crosby & Bishop 1935)				1		1	
Hypomma marxi (Keyserling 1886)					1	1	
Hypselistes florens (O. P.-Cambridge 1875)	1	1	1	1	1	5	
Idionella formosa (Banks 1892)			1		1	2	
Idionella rugosa (Crosby 1905)	1				1	2	
Idionella sclerata (Ivie & Barrows 1935)	1	P			1	2	
Incestophantes calcaratus (Emerton 1909)					1	1	
Incestophantes duplicatus (Emerton 1913)					1	1	
Islandiana flaveola (Banks 1892)	1	P	1	P	1	3	
Islandiana flavoides Ivie 1965	1					1	
Islandiana longisetosa (Emerton 1882)	1	1	1	P	1	4	
Islandiana speophila Ivie 1965			1			1	
Kaestneria pullata (O. P.-Cambridge 1863)	1	P	P	1	1	3	H
Lepthyphantes intricatus (Emerton 1911)				1		1	
Lepthyphantes leprosus (Ohlert 1865)	1	P	1	1	1	4	H
Lepthyphantes minutus (Blackwall 1883)					1	1	
Lepthyphantes turbatrix (O. P.-Cambridge 1877)	P	P	1	1	1	3	
Macrargus multesimus (O. P.-Cambridge 1875)	P	P	1	1	1	3	H
Maso sundevalli (Westring 1851)				1	1	2	H
Megalepthyphantes nebulosus (Sundevall 1830)	1	1	1	1	1	5	H
Meioneta angulata (Emerton 1882)			1		1	2	
Meioneta barrowsi Chamberlin & Ivie 1944	1	P	1			2	
Meioneta brevipes (Keyserling 1886)			1			1	
Meioneta evadens (Chamberlin 1925)	1					1	
Meioneta fabra (Keyserling 1886)	1	1	1	P	1	4	
Meioneta leucophora Chamberlin & Ivie 1944	1					1	
Meioneta micaria (Emerton 1882)	1	1	1			3	
Meioneta officiosa (Barrows 1940)			1			1	
Meioneta serrata (Emerton 1909)					1	1	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Meioneta simplex (Emerton 1926)	1	P			1	2	
Meioneta unimaculata (Banks 1892)	1	1	1	1	1	5	
Meioneta zygia (Keyserling 1886)	1					1	
Microlinyphia pusilla (Sundevall 1830)	1	P	1	P	1	3	H
Microlinyphia impigra (O. P.-Cambridge 1871)	1	P	1			2	H
Microlinyphia mandibulata (Emerton 1882)	1	1	1	1	1	5	
Microneta viaria (Blackwall 1841)	1	P	1	1	1	4	H
Mythoplastoides exiguus (Banks 1892)		1				1	
Neriene clathrata (Sundevall 1830)	1	1	1	1	1	5	H
Neriene radiata (Walckenaer 1842)	1	1	1	1	1	5	H
Neriene variabilis (Banks 1892)	1	1	1	1	1	5	
Oedothorax maximus (Emerton 1882)			1			1	
Oedothorax montifer (Emerton 1882)		1				1	
Oedothorax trilobatus (Banks 1896)	1	P	P	1	1	3	
Oreonetides rotundus (Emerton 1913)					1	1	
Oreonetides vaginatus (Thorell 1872)					1	1	H
Origanates rostratus (Emerton 1882)	1	1	1	1	1	5	
Paracornicularia bicapillata Crosby & Bishop 1931	1					1	
Pelecopsis bishopi Kaston 1945		1			1	2	
Pelecopsis moesta (Banks 1892)			1		1	2	
Phanetta subterranea (Emerton 1875)	1	1				2	
Pityohyphantes costatus (Hentz 1850)	1	1	1	1	1	5	
Pityohyphantes limitaneus (Emerton 1915)					1	1	
Pocadicnemus americana Millidge 1976	1	P	P	1	1	3	
Poeciloneta bihamata (Emerton 1882)					1	1	
Poeciloneta furcata (Emerton 1913)				1		1	
Poeciloneta theridiformis (Emerton 1911)	1					1	H
Porrhomma cavernicola (Keyserling 1886)	1	1				2	
Porrhomma terrestre (Emerton 1882)	1	P	1	1	1	4	
Satilatlas arenarius (Emerton 1911)	1	P	1	1	1	4	
Sciastes acuminatus (Emerton 1913)	1			1		2	
Sciastes truncatus (Emerton 1822)				1		1	
Scirites pectinatus (Emerton 1911)	1			1		2	
Scironis tarsalis (Emerton 1911)	1	P			1	2	
Scotinotylus pallidus (Emerton 1882)					1	1	
Scotinotylus vernalis (Emerton 1882)					1	1	
Scylaceus pallidus (Emerton 1882)	1	1	1	1	1	5	
Scyletria jona Bishop & Crosby 1938	1					1	
Sisicottus montanus (Emerton 1882)					1	1	
Sisicottus montigenus Bishop & Crosby 1938					1	1	
Sisicus penifusifer Bishop & Crosby 1938				1	1	2	
Sitalcas ruralis Bishop & Crosby 1938	1					1	
Souessa spinifera (O. P.-Cambridge 1874)				1		1	
Souessoula parva (Banks 1899)	1					1	
Sougambus bostoniensis (Emerton 1882)				1		1	
Soulgas corticarius (Emerton 1909)	1			1	1	3	
Stemonyphantes blauveltae Gertsch 1951	1	1	1			3	
Styloctetor purpurescens (Keyserling 1886)	1	P	1	1	P	3	
Tapinocyba emertoni Barrows & Ivie 1942			1			1	
Tapinocyba hortensis (Emerton 1924)			1			1	
Tapinocyba minuta (Emerton 1909)				1	1	2	
Tapinocyba scopulifera (Emerton 1882)	1	P			1	2	
Tapinocyba simplex (Emerton 1882)				1	1	2	
Tapinocyba sucra Chamberlin 1949			1			1	
Tapinopa bilineata Banks 1893	1	P	1	1	1	4	
Taranucnus ornithes (Barrows 1940)			1			1	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Tennesseellum formica (Emerton 1882)	1	1	1	1	1	5	
Tenuiphantes sabulosus (Keyserling 1886)	1	P	1	1	1	4	
Tenuiphantes zebra (Emerton 1882)	1	1	1	1	1	5	
Thyreosthenius parasiticus (Westring 1851)	P	P	1	1	P	2	H
Tmeticus ornatus (Emerton 1914)	1		P	1	1	3	
Traematosisis bispinosis (Emerton 1911)					1	1	
Tunagyna debilis (Banks 1892)				1	1	2	
Tusukuru hartlandianus (Emerton 1913)					1	1	
Tutaibo anglicanus (Hentz 1850)	1	1				2	
Walckenaeria atrotibialis (O. P.-Cambridge 1878)	1	P	P	1	1	3	H
Walckenaeria auranticeps (Emerton 1882)					1	1	
Walckenaeria brevicornis (Emerton 1882)	1	P	1	1	1	4	
Walckenaeria castanea (Emerton 1882)	1	P	1	1	1	4	
Walckenaeria clavicornis (Emerton 1882)	P	P	1	1	1	3	H
Walckenaeria communis (Emerton 1882)	1	P	1	1	1	4	
Walckenaeria digitata (Emerton 1913)	1					1	
Walckenaeria directa (O. P.-Cambridge 1874)	1	P	1	1	1	4	
Walckenaeria exigua Millidge 1983				1	1	2	
Walckenaeria indirecta (O. P.-Cambridge 1874)	1	P	P	1	1	3	
Walckenaeria minuta (Emerton 1882)	1	1	1	1	1	5	
Walckenaeria pallida (Emerton 1882)	1	P	1	1	1	4	
Walckenaeria palustris Millidge 1983	1					1	
Walckenaeria pinocchio (Kaston 1945)					1	1	
Walckenaeria redneri Millidge 1983				1		1	
Walckenaeria spiralis (Emerton 1882)	1	1	1	1	1	5	
Walckenaeria subdirecta Millidge 1983	1	1	P	P	1	3	
Walckenaeria subpallida Millidge 1983	1					1	
Walckenaeria tibialis (Emerton 1882)			1		1	2	
Wubana drassoides (Emerton 1882)	1	P	1			2	
Liocranidae							
Agroeca minuta (Banks 1895)	1	1	1			3	
Agroeca ornata Banks 1892	1	P	P	1	1	3	
Agroeca pratensis Emerton 1890	P	1	1	1	1	4	
Lycosidae							
Allocosa funerea (Hentz 1844)	1	1	1	P	1	4	
Allocosa georgicola (Walckenaer 1837)	1	1	P	P	1	3	
Allocosa noctuabunda (Montgomery 1904)		1				1	
Allocosa sublata (Montgomery 1902)		1				1	
Alopecosa aculeata (Clerck 1757)	P	P	1	1	1	3	H
Alopecosa kochi (Keyserling 1877)					1	1	
Arctosa emertoni Gertsch 1934	1	1	P	1	1	4	
Arctosa littoralis (Hentz 1844)	1	1	1	1	1	5	
Arctosa raptor (Kulczyñski 1885)					1	1	
Arctosa rubicunda (Keyserling 1877)	P	1	1	1	1	4	
Arctosa virgo (Chamberlin 1925)			1		1	2	
Geolycosa fatifera (Hentz 1842)					1	1	
Geolycosa missouriensis (Banks 1895)	1	1	1	1	1	5	
Geolycosa pikei (Marx 1881)					1	1	
Geolycosa sepulchralis (Montgomery 1902)			1			1	
Geolycosa turricola (Treat 1880)			1		1	2	
Geolycosa wrighti (Emerton 1912)	1	1	1	1	1	5	
Gladicosa bellamyi (Gertsch & Wallace 1937)			1			1	
Gladicosa gulosa (Walckenaer 1837)	1	1	1	1	1	5	
Gladicosa pulchra (Keyserling 1877)	1	P	1			2	
Hogna aspersa (Hentz 1844)	1	1	1	1	1	5	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Hogna baltimoriana (Keyserling 1877)	1	1	1	1	1	5	
Hogna carolinensis (Walckenaer 1805)	1	1	1	1	1	5	
Hogna frondicola (Emerton 1885)	1	1	1	1	1	5	
Hogna helluo (Walckenaer 1837)	1	1	1	1	1	5	
Hogna lenta (Hentz 1844)			1			1	
Hogna permunda (Chamberlin 1904)	1					1	
Pardosa distincta (Blackwall 1846)	1	P	1	1	1	4	
Pardosa fuscula (Thorell 1875)	1	1	P	1	1	4	
Pardosa glacialis (Thorell 1872)			1		1	2	H
Pardosa groenlandica (Thorell 1872)				1	1	2	
Pardosa hyperborea (Thorell 1872)					1	1	H
Pardosa lapidicina Emerton 1885	1	1	1	1	1	5	
Pardosa littoralis Banks 1896					1	1	
Pardosa mackenziana (Keyserling 1877)				1	1	2	
Pardosa milvina (Hentz 1844)	1	1	1	1	1	5	
Pardosa modica (Blackwall 1846)	1	1	1	1	1	5	
Pardosa moesta Banks 1892	1	1	1	1	1	5	
Pardosa saxatilis (Hentz 1844)	1	P	1	1	1	4	
Pardosa sternalis (Thorell 1877)					1	1	
Pardosa xerampelina (Keyserling 1877)	1	1	1	1	1	5	
Pirata alachuus Gertsch & Wallace 1935	1	1	1			3	
Pirata apalacheus Gertsch 1940	1	1				2	
Pirata aspirans Chamberlin 1904	1	1	1	1	1	5	
Pirata cantralli Wallace & Exline 1978				1	1	2	
Pirata giganteus Gertsch 1934	1			1		2	
Pirata indigenus Wallace & Exline 1978				1		1	
Pirata insularis Emerton 1885	1	1	1	1	1	5	H
Pirata minutus Emerton 1885	1	1	1	1	1	5	
Pirata montanoides Banks 1892	1	P			1	2	
Pirata montanus Emerton 1885	1	1	1	1	1	5	
Pirata piraticus (Clerck 1757)	1	1	1	P	1	4	H
Pirata sedentarius Montgomery 1904	1	1	1	1	1	5	
Pirata seminolus Gertsch & Wallace 1935					1	1	
Pirata spiniger (Simon 1898)	1					1	
Pirata sylvanus Chamberlin & Ivie 1944	1					1	
Pirata triens Wallace & Exline 1978	1					1	
Pirata zelotes Wallace & Exline 1978	1	P	1	1	1	4	
Rabidosa hentzi Banks 1904	1					1	
Rabidosa punctulata (Hentz 1844)	1	1	1	P	1	4	
Rabidosa rabida (Walckenaer 1837)	1	1	1	P	1	4	
Schizocosa aulonia Dondale 1969	1	1				2	
Schizocosa avida (Walckenaer 1837)	1	1	1	1	1	5	
Schizocosa bilineata (Emerton 1885)	1	1	1	1	1	5	
Schizocosa crassipalpata Roewer 1951	1	1	1	1	1	5	
Schizocosa crassipes (Walckenaer 1837)	1			1	1	3	
Schizocosa duplex Chamberlin 1925			1		1	2	
Schizocosa mccooki (Montgomery 1904)	1	P	P	1	1	3	
Schizocosa ocreata (Hentz 1844)	1	1	1	1	1	5	
Schizocosa retrorsa (Banks 1911)	1	P	1			2	
Schizocosa rovneri Uetz & Dondale 1979	1	P	1			2	
Schizocosa saltatrix (Hentz 1844)	1	1	1	1	1	5	
Schizocosa stridulans Stratton 1984	1	P	1			2	
Trabeops aurantiacus (Emerton 1885)	1	1	1	1	1	5	
Trebacosa marxi (Stone 1890)	1	1	1	P	1	4	
Trochosa ruricola (DeGeer 1778)	1					1	H
Trochosa terricola Thorell 1856	1	1	1	1	1	5	H

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Varacosa avara (Keyserling 1877)	1	1	1	1	1	5	
Varacosa shenandoa (Chamberlin & Ivie 1942)	1					1	
Mimetidae							
Ero canionis Chamberlin & Ivie 1935	P	P	1	1	P	2	
Ero leonina (Hentz 1850)	1	1	1	1	1	5	
Mimetus epeiroides Emerton 1882	1	1	1	1	1	5	
Mimetus nelsoni Archer 1950			1			1	
Mimetus notius Chamberlin 1923	1			1		2	
Mimetus puritanus Chamberlin 1923	1	1	1	1	1	5	
Mimetus syllepsicus Hentz 1832			1		1	2	
Miturgidae							
Cheiracanthium inclusum (Hentz 1847)	1	1	1	P	1	4	
Cheiracanthium mildei L. Koch 1864	1	P	1	1	P	3	PA
Strotarchus piscatorius (Hentz 1847)	1	P	1			2	
Mysmenidae							
Maymena ambita (Barrows 1940)	1	P	1			2	
Microdipoena guttata Banks 1895	1		1			2	
Nesticidae							
Eidmannella pallida (Emerton 1875)	1	P	1	1	P	3	C
Nesticus bishopi Gertsch 1984		1				1	
Nesticus carteri Emerton 1875		1				1	
Oecobiidae							
Oecobius cellariorum (Dugès 1836)	1	P	1			2	C
Oecobius navus Blackwall 1859			1			1	C
Oonopidae							
Orchestina saltitans Banks 1894	1	P	1	P	1	3	
Oxyopidae							
Oxyopes aglossus Chamberlin 1929	1					1	
Oxyopes salticus Hentz 1845	1	1	1	1	1	5	
Oxyopes scalaris Hentz 1845	1	P	1	1	1	4	
Philodromidae							
Ebo iviei Sauer & Platnick 1972					1	1	
Ebo latithorax Keyserling 1884	1	1	1	1	1	5	
Ebo pepinensis Gertsch 1933	1	1	P	P	1	3	
Philodromus alascensis Keyserling 1884	1	1	P	P	1	3	H
Philodromus bimuricatus Dondale & Redner 1968	1					1	
Philodromus cespitum (Walckenaer 1802)	1	1	1	1	1	5	H
Philodromus exilis Banks 1892				1	1	2	
Philodromus histrio (Latreille 1819)				1	1	2	H
Philodromus imbecillus Keyserling 1880	1	1	1	1	1	5	
Philodromus infuscatus Keyserling 1880	1	P	1	1	1	4	
Philodromus keyserlingi Marx 1890	1	1	1	1	1	5	
Philodromus marxi Keyserling 1884	1	1	1	1	1	5	
Philodromus mineri Gertsch 1933					1	1	
Philodromus minutus Banks 1892	1	1	1	1	1	5	
Philodromus montanus Bryant 1933	1					1	
Philodromus oneida Levi 1951	1	P	P	1	1	3	
Philodromus peninsulanus Gertsch 1934					1	1	
Philodromus pernix Blackwall 1846	1	P	P	1	1	3	
Philodromus placidus Banks 1892	1	1	1	1	1	5	
Philodromus praelustris Keyserling 1880	1	1	P	1	1	4	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Philodromus pratariae (Scheffer 1904)	1					1	
Philodromus rufus Walckenaer 1826	1	1	1	1	1	5	H
Philodromus rufus quartus Dondale & Redner 1968					1	1	
Philodromus rufus vibrans Dondale 1964	1	P	P	1	1	3	
Philodromus satullus Keyserling 1880	P	P	1	1	1	3	
Philodromus vulgaris (Hentz 1847)	1	1	1	1	1	5	
Thanatus coloradensis Keyserling 1880					1	1	H
Thanatus formicinus (Clerck 1757)	1	1	1	1	1	5	H
Thanatus rubicellus Mello-Leitao 1929	1	P			1	2	
Thanatus striatus C. L. Koch 1845	1	P	P	1	1	3	H
Thanatus vulgaris Simon 1870			1			1	H
Tibellus duttoni (Hentz 1847)	1	1	1	P	1	4	
Tibellus maritimus (Menge 1875)	1	1	1	1	1	5	H
Tibellus oblongus (Walckenaer 1802)	1	1	1	1	1	5	H
Pholcidae							
Pholcus phalangioides (Fuesslin 1775)	1	1	1	1	1	5	C
Spermophora senoculata (Dugès 1836)	1	1	1	1	P	4	C
Pisauridae							
Dolomedes albineus Hentz 1845	1					1	
Dolomedes scriptus Hentz 1845	1	1	1	1	1	5	
Dolomedes striatus Giebel 1869	1	1	1	1	1	5	
Dolomedes tenebrosus Hentz 1844	1	1	1	1	1	5	
Dolomedes triton (Walckenaer 1837)	1	1	1	1	1	5	
Dolomedes vittatus Walckenaer 1837	1	1	1	P	1	4	
Pisaurina brevipes (Emerton 1911)	1	1	1	P	1	4	
Pisaurina dubia (Hentz 1847)	1	P	1			2	
Pisaurina mira (Walckenaer 1837)	1	1	1	1	1	5	
Pisaurina undulata (Keyserling 1846)	1	1				2	
Salticidae							
Admestina tibialis (C. L. Koch 1846)	1	1	1	1	1	5	
Admestina wheeleri Peckham & Peckham 1888				1	1	2	
Agassa cyaena (Hentz 1846)	1	1	1			3	
Attidops youngi (Peckham & Peckham 1888)	1	P	1	1	P	3	
Chinattus parvulus (Banks 1895)	1	P	1	1	P	3	
Eris aurantia (Lucas 1833)	1	1	1			3	
Eris flava (Peckham & Peckham 1888)	1			1		2	
Eris floridana (Banks 1904)			1			1	
Eris militaris (Hentz 1845)	1	1	1	1	1	5	
Eris pinea (Kaston 1945)	1	1	1			3	
Euophrys monadnock Emerton 1891	P	P	1	1	P	2	
Evarcha hoyi (Peckham & Peckham 1883)	1	1	1	1	1	5	
Ghelna barrowsi (Kaston 1973)			1			1	
Ghelna canadensis (Banks 1897)	1	1	1	1	1	5	
Habronattus agilis (Banks 1893)	1	1	1	P	1	4	M?
Habronattus borealis (Banks 1895)	1	1	1	1	1	5	
Habronattus calcaratus (Banks 1904)	1	1	1	P	1	4	
Habronattus captiosus (Gertsch 1934)				1	1	2	
Habronattus coecatus (Hentz 1846)	1	P	1	P	1	3	
Habronattus cognatus (Peckham & Peckham 1901)	1	1	1	P	1	4	
Habronattus conjunctus (Banks 1898)	1					1	
Habronattus decorus (Blackwall 1846)	1	P	1	1	1	4	
Habronattus orbus Griswold 1987			1			1	
Habronattus texanus (Chamberlin 1924)	1	P	1	P	1	3	
Habronattus viridipes (Hentz 1846)	1	P	1	1	1	4	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Hasarius adansoni (Audouin 1826)	1	1		1		3	C
Hentzia mitrata (Hentz 1846)	1	1	1	1	1	5	
Hentzia palmarum (Hentz 1832)	1	1	1	1	1	5	
Maevia inclemens (Walckenaer 1837)	1	1	1	1	1	5	
Marpissa bina (Hentz 1846)	1	P	P	1	1	3	
Marpissa dentoides Barnes 1958			1			1	
Marpissa formosa (Banks 1892)	1	1	1	1	1	5	
Marpissa grata (Gertsch 1936)	1	P	P	1	1	3	
Marpissa lineata (C. L. Koch 1846)	1	1	1	1	1	5	
Marpissa pikei (Peckham & Peckham 1888)	1	1	1	1	1	5	
Metacyrba taeniola (Hentz 1846)	1			1		2	
Myrmarachne formicaria (DeGeer 1778)			1			1	PA
Naphrys pulex (Hentz 1846)	1	1	1	1	1	5	
Neon ellamae Gertsch & Ivie 1955				1		1	
Neon nelli Peckham & Peckham 1888	1	P	1	1	1	4	
Neon plutonus Gertsch & Ivie 1955	1					1	
Paradamoetas fontanus (Levi 1951)				1		1	
Peckhamia americana (Peckham & Peckham 1892)	1	1	1			3	
Peckhamia picata (Hentz 1846)	1	P	1	1	1	4	
Peckhamia scorpionia (Hentz 1846)			1		1	2	
Pelegrina chalceola Maddison 1996	1					1	
Pelegrina exigua (Banks 1892)	1	P	1			2	
Pelegrina flaviceps (Kaston 1973)				1		1	
Pelegrina flavipes (Peckham & Peckham 1888)	1	1	P	1	1	4	
Pelegrina galathea (Walckenaer 1837)	1	1	1	1	1	5	
Pelegrina insignis (Banks 1892)	1	1	1	1	1	5	
Pelegrina montana (Emerton 1891)				1	1	2	M?
Pelegrina peckhamorum (Kaston 1973)			1			1	
Pelegrina proterva (Walckenaer 1837)	1	1	1	1	1	5	
Pellenes longimanus Emerton 1913					1	1	
Phidippus apacheanus Chamberlin & Gertsch *1929*				1		1	
Phidippus audax (Hentz 1845)	1	1	1	1	1	5	
Phidippus borealis Banks 1895				1	1	2	
Phidippus cardinalis (Hentz 1845)	1	1	1	1	1	5	
Phidippus clarus Keyserling 1885	1	1	1	1	1	5	
Phidippus insignarius C. L. Koch 1846	1	P	1	1	1	4	
Phidippus mystaceus (Hentz 1846)	1	P	1	P	1	3	
Phidippus pius Scheffer 1905	1	P	1	P	1	3	
Phidippus princeps (Peckham & Peckham 1883)	1	1	1	1	1	5	
Phidippus purpuratus Keyserling 1885	1	1	1	1	1	5	
Phidippus putnami (Peckham & Peckham 1883)	1	1	1			3	
Phidippus whitmani Peckham & Peckham 1909	1	1	1	1	1	5	
Phlegra hentzi (Marx 1890)	1	1	1	1	1	5	
Platycryptus undatus (DeGeer 1778)	1	1	1	1	1	5	
Salticus scenicus (Clerck 1757)	1	1	1	1	1	5	PA
Sarinda hentzi (Banks 1913)	1	P	1			2	
Sassacus papenhoei Peckham & Peckham 1895	1	P	1	1	P	3	
Sibianor aemulus (Gertsch 1934)				1		1	
Sitticus concolor (Banks 1895)	1			1		2	
Sitticus dorsatus (Banks 1895)	1					1	
Sitticus fasciger (Simon 1880)	1			1		2	A
Sitticus floricola palustris (Peckham & Peckham 1883)	1	1	1	1	1	5	
Sitticus striatus Emerton 1911				1		1	H
Synageles canadensis Cutler 1988					1	1	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Synageles noxiosus (Hentz 1850)	1	P	1	1	1	4	
Synageles occidentalis Cutler 1988	1			1		2	
Synemosyna formica Hentz 1846	1	1	1	1	1	5	
Talavera minuta (Banks 1895)	1	1	1	1	1	5	
Thiodina puerpera (Hentz 1846)	1		1			2	
Thiodina sylvana (Hentz 1846)	1	1	1			3	
Tutelina elegans (Hentz 1846)	1	1	1	1	1	5	
Tutelina formicaria (Emerton 1891)	1	P	1	P	1	3	
Tutelina harti (Peckham in Emerton 1891)	1	1	1	1	1	5	
Tutelina similis (Banks 1895)	1	1	1	1	1	5	
Zygoballus nervosus (Peckham 1888)	1	1	1	1	1	5	
Zygoballus rufipes Peckham & Peckham 1885	1	1	1	1	1	5	
Zygoballus sexpunctatus (Hentz 1845)	1	P	1			2	
Scytodidae							
Scytodes thoracica (Latreille 1802)	1	1	1	1	1	5	H
Segestriidae							
Ariadna bicolor (Hentz 1842)	1	1	1			3	
Sicariidae							
Loxosceles reclusa Gertsch & Mulaik 1940	1	1	1			3	
Loxosceles rufescens (Dufour 1820)	1	P	1			2	C
Tengellidae							
Liocranoides tennesseensis (Platnick 1999)			1			1	
Tetragnathidae							
Dolichognatha pentagona (Hentz 1850)	1					1	
Glenognatha foxi (McCook 1894)	1	1	1	1	P	4	
Leucauge venusta (Walckenaer 1842)	1	1	1	1	1	5	
Meta ovalis (Gertsch 1933)	1	1	1	1	P	4	
Metellina curtisi (McCook 1893)				1		1	
Pachygnatha autumnalis Marx 1884	1	P	1	P	1	3	
Pachygnatha brevis Keyserling 1884	1	1	1	P	1	4	
Pachygnatha dorothea McCook 1894	1	P	1	1	1	4	
Pachygnatha furcillata Keyserling 1884		1	1			2	
Pachygnatha tristriata C. L. Koch 1845	1	1	1	1	1	5	
Pachygnatha xanthostoma C. L. Koch 1845	1	1	1	1	1	5	
Tetragnatha caudata Emerton 1884	1	1	1	1	1	5	
Tetragnatha dearmata Thorell 1873	1			1	1	3	H
Tetragnatha elongata Walckenaer 1842	1	1	1	1	1	5	
Tetragnatha extensa (Linnaeus 1758)		1			1	2	H
Tetragnatha guatemalensis O. P.-Cambridge 1889	1	1	1	1	1	5	
Tetragnatha laboriosa Hentz 1850	1	1	1	1	1	5	
Tetragnatha pallescens F.O.P.-Cambridge 1903	1	1	1	1	1	5	
Tetragnatha shoshone Levi 1981	1	P	1			2	
Tetragnatha straminea Emerton 1884	1	1	1	1	1	5	
Tetragnatha vermiformis Emerton 1884	1	1	P	1	1	4	
Tetragnatha versicolor Walckenaer 1842	1	1	1	1	1	5	
Tetragnatha viridis Walckenaer 1842					1	1	
Theridiidae							
Achaearanea conjuncta (Gertsch & Mulaik 1936)			1			1	
Achaearanea globosa (Hentz 1850)	1	P	1	1	1	4	
Achaearanea porteri (Banks 1896)	1	1	1			3	
Achaearanea rupicola (Emerton 1882)	1	1	1	1	P	4	
Achaearanea tabulata Levi 1980	1					1	PA

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Achaearanea tepidariorum (C. L. Koch 1841)	1	1	1	1	1	5	C
Anelosimus studiosus (Hentz 1850)	1	P			1	2	
Argyrodes elevatus Taczanowski 1873	1					1	
Crustulina altera Gertsch & Archer 1942	1	1	1	1	1	5	
Crustulina sticta (O. P.-Cambridge 1861)	1	1	1	1	1	5	H
Dipoena buccalis Keyserling 1886			1		1	2	
Dipoena nigra (Emerton 1882)	1	P	1	1	1	4	
Enoplognatha caricis (Fickert 1876)	1	P	1	1	1	4	H
Enoplognatha intrepida (Sørensen 1898)	1	P	P	1	1	3	
Enoplognatha joshua Chamberlin & Ivie 1942	1					1	
Enoplognatha marmorata (Hentz 1850)	1	1	1	1	1	5	
Enoplognatha ovata (Clerck 1757)	1	P	1	1	1	4	PA
Episinus amoenus Banks 1911			1			1	
Euryopis argentea Emerton 1882	1	1	1	1	1	5	
Euryopis funebris (Hentz 1850)	1	1	1	1	1	5	
Euryopis gertschi Levi 1951	1	1				2	
Euryopis pepini Levi 1954	P	P	1	1	P	2	
Euryopis quinquemaculata Banks 1900	1	P	1			2	
Euryopis saukea Levi 1951				1		1	H
Faiditus cancellatus (Hentz 1850)	1	P	1			2	
Keijia alabamensis Gertsch & Archer 1942	1	1	1	1	P	4	
Keijia antoni Keyserling 1884	1	P	1			2	
Keijia punctosparsa Emerton 1882	1	1	1	1	1	5	
Lasaeola prona (Menge 1868)	1					1	H
Latrodectus mactans (Fabricius 1775)	1	1	1	P	1	4	
Latrodectus variolus Walckenaer 1837	1	1	1	1	1	5	
Neospintharus trigonum (Hentz 1850)	1	1	1	1	1	5	
Pholcomma hirsutum Emerton 1882	1	1	1	1	P	4	
Phoroncidia americana (Emerton 1882)	1	1	1	P	1	4	
Rhomphaea fictilium (Hentz 1850)	1	P	1			2	
Robertus banksi (Kaston 1946)				1		1	
Robertus borealis (Kaston 1946)					1	1	
Robertus eremophilus (Chamberlin in Chamberlin & Gertsch 1928)	1			1		2	
Robertus frontatus (Banks 1892)	1	P	1			2	
Robertus fuscus (Emerton 1894)				1	1	2	
Robertus laticeps (Keyserling 1884)	1	P	P	1	1	3	
Robertus longipalpus (Kaston 1946)	1			1		2	
Robertus pumilis (Emerton 1909)		1				1	
Robertus riparius (Keyserling 1886)	1	1	1	1	1	5	
Robertus similis (Kaston 1946)					1	1	
Robertus spinifer (Emerton 1909)				1	1	2	
Rugathodes aurantius (Emerton 1915)				1	1	2	H
Rugathodes sexpunctatus (Emerton 1882)	P	P	1	1	1	3	
Spintharus flavidus Hentz 1850	1	P	1			2	
Steatoda albomaculata (DeGeer 1778)	1	1	1	1	1	5	C
Steatoda americana (Emerton 1882)	1	1	1	1	1	5	
Steatoda borealis (Hentz 1850)	1	1	1	1	1	5	
Steatoda grossa (C. L. Koch 1838)		1	1			2	C
Steatoda triangulosa (Walckenaer 1802)	1	1	1	1	1	5	C
Stemmops ornatus (Bryant 1933)	1	P	1			2	
Takayus lyricus (Walckenaer 1842)	1	1	1	1	1	5	H
Theonoe stridula Crosby 1906				1	1	2	
Theridion albidum Banks 1895	1	1	1	1	1	5	
Theridion cheimatos Gertsch & Archer 1942			1			1	
Theridion differens Emerton 1882	1	1	1	1	1	5	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Theridion dividuum Gertsch & Archer 1942				1		1	
Theridion flavonotatum Becker 1879	1	P	1			2	
Theridion frondeum Hentz 1850	1	1	1	1	1	5	
Theridion glaucescens Becker 1879	1	1	1	1	1	5	
Theridion hemerobium (Simon 1914)	1	P	1	1	1	4	
Theridion llano Levi 1957	1					1	
Theridion montanum Emerton 1882					1	1	
Theridion murarium Emerton 1882	1	1	1	1	1	5	
Theridion neshamini Levi 1957	1	P	1			2	
Theridion pennsylvanicum Emerton 1913	1	1	1			3	
Theridion petraeum L. Koch 1872					1	1	H
Theridion pictipes Keyserling 1884	1	P	1			2	
Theridion pictum (Walckenaer 1802)	1	1	P	1	1	4	H
Theridion rabuni Chamberlin & Ivie 1944	1					1	
Theridula emertoni Levi 1954	1	P	1	1	1	4	
Theridula opulenta (Walckenaer 1842)	1	1	1	P	1	4	C
Thymoites marxi (Crosby 1906)			1			1	
Thymoites pallidus (Emerton 1913)	1	1				2	
Thymoites unimaculatus (Emerton 1882)	1	1	1	1	1	5	
Wamba crispulus (Simon 1895)	1	P	1			2	
Theridiosomatidae							
Theridiosoma gemmosum L. Koch 1877	1	1	1	1	1	5	
Thomisidae							
Bassaniana floridana Banks 1896			1			1	
Bassaniana utahensis (Gertsch 1932)	1	P			1	2	
Bassaniana versicolor (Keyserling 1880)	1	1	1	1	1	5	
Misumena vatia (Clerck 1757)	1	1	1	1	1	5	H
Misumenoides formosipes (Walckenaer 1837)	1	1	1	1	1	5	
Misumenops asperatus (Hentz 1847)	1	1	1	1	1	5	
Misumenops celer (Hentz 1847)	1	P	1	P	1	3	
Misumenops oblongus (Keyserling 1880)	1	1	1	1	1	5	
Ozyptila americana Banks 1895	1	1	1	1	1	5	
Ozyptila conspurcata Thorell 1877	1	1	P	1	1	4	
Ozyptila creola Gertsch 1953			1			1	
Ozyptila curvata Dondale & Redner 1975			1			1	
Ozyptila distans Dondale & Redner 1975					1	1	
Ozyptila georgiana Keyserling 1880	1	P			1	2	
Ozyptila modesta (Scheffer 1904)	P	P	1	1	P	2	
Ozyptila monroensis Keyserling 1884	1	1	1	1	1	5	
Synema parvulum (Hentz 1847)	1	1	1			3	
Tmarus angulatus (Walckenaer 1837)	1	1	1	1	1	5	
Tmarus minutus Banks 1904			1			1	
Tmarus rubromaculatus Keyserling 1880		1				1	
Xysticus alboniger Turnbull, Dondale & Redner 1965	1	P	1	P	1	3	
Xysticus ampullatus Turnbull, Dondale & Redner 1965				1	1	2	
Xysticus auctificus Keyserling 1880	1	1	1	1	1	5	
Xysticus banksi Bryant 1933	1	1	P	P	1	3	
Xysticus bicuspis Keyserling 1887	1	1	1	1	1	5	
Xysticus canadensis Gertsch 1934					1	1	
Xysticus chippewa Gertsch 1953					1	1	H
Xysticus cunctator Thorell 1877	1					1	
Xysticus discursans Keyserling 1880	1	1	1	1	1	5	

Table 8.—Continued.

Species	IL	IN	OH	WI	MI	S	D
Xysticus elegans Keyserling 1880	1	1	1	1	1	5	
Xysticus ellipticus Turnbull, Dondale & Redner 1965					1	1	
Xysticus emertoni Keyserling 1880	1	P	1	1	1	4	
Xysticus ferox (Hentz 1847)	1	1	1	1	1	5	
Xysticus fervidus Gertsch 1953	1					1	
Xysticus fraternus Banks 1895	1	1	1	1	1	5	
Xysticus funestus Keyserling 1880	1	1	1	1	1	5	
Xysticus gulosus Keyserling 1880	1	1	1	1	1	5	
Xysticus luctans (C. L. Koch 1845)	1	1	1	1	1	5	
Xysticus luctuosus (Blackwall 1836)				1	1	2	H
Xysticus nevadensis (Keyserling 1880)				1		1	
Xysticus pellax O. P.-Cambridge 1894	1	P	1	1	1	4	
Xysticus posti Sauer 1968					1	1	
Xysticus punctatus Keyserling 1880				1	1	2	
Xysticus texanus Banks 1904	1	1				2	
Xysticus triguttatus Keyserling 1880	1	1	1	1	1	5	
Titanoecidae							
Titanoeca americana Emerton 1888	1	1	1	1	1	5	
Titanoeca brunnea Emerton 1888	1	1	1			3	
Uloboridae							
Hyptiotes cavatus (Hentz 1847)	1	1	1	1	1	5	
Octonoba sinensis (Simon 1880)	1	1	1			3	
Uloborus glomosus (Walckenaer 1842)	1	1	1	1	1	5	
Zoridae							
Zora pumila (Hentz 1850)	1	1	1			3	
Total	646	383	571	479	583		

lished populations occur in southern Wisconsin, Illinois, Indiana, and Ohio, but the species has apparently not yet been collected in Michigan. Both the Field Museum in Illinois and the Milwaukee Public Museum in Wisconsin house voucher specimens.

Three non-native gnaphosid species, *Trachyzelotes lyonneti* (Audouin), *Urozelotes rusticus* (L. Koch), and *Zelotes subterraneus* C. L. Koch have been reported from one or more of the five Great Lakes states. In their revision of *Trachyzelotes* and *Urozelotes,* Platnick & Murphy (1984) examined only one female specimen of *T. lyonneti* from the five-state region; this specimen was taken from under a rock in a backyard in Alton, Madison County, Illinois. The species is not a synanthropic/cosmopolitan species and appears to be more tolerant of drier conditions than *U. rusticus.* Until additional specimens are discovered, the species' establishment in Illinois is doubtful; we have removed the species on our updated species list (Table 8, Appendix I, see Appendix II). *Urozelotes rusticus* is considered a cosmopolitan species and reported from Wisconsin, Illinois, and Ohio. Platnick and Murphy (1984) examined material from both Wisconsin and Illinois but since that time, the species appears to have become established in Ohio as well. The Palearctic species *Zelotes subterraneus* is reported from all five states. However, Platnick & Shadab (1983) removed *Z. fratris* Chamberlin from the synonymy of *Z. subterraneus* and stated that the species was often misidentified as *Z. subterraneus* because of their similarity. The native species is very widely distributed in the USA except in the southeast and south-central parts of the country; it is known from the northern parts of Illinois, Indiana, and Ohio and is widely distributed in Wisconsin and Michigan. It is very unlikely that *Z. subterraneus* occurs in North America; and that, instead, its multiple listings were the result of misidentifications. It is not included on our updated list.

Eight Palearctic or European linyphiid species were recorded from the five-state region. Five of these species were reported only from Michigan: *Agyneta cauta* (O.P.-Cambridge), *Bathyphantes nigrinus* (Westring), *Centromerus serratus* (O.P.-Cambridge), *Pityohyphantes phrygianus* (C.L. Koch), and *Walckenaria acuminata* Blackwall. Voucher specimens of four of these species are in the Michigan State University Entomology Collection: *B. nigrinus, C. serratus, P. phrygianus, W. acuminata.* Since there are no voucher specimens of *A. cauta,* we regard the record as a misidentification. Records and voucher specimen(s) of *C. serratus* and *W. acuminata* are from only one locality each and voucher specimen(s) of *B. nigrinus* from only one locality; the *Walckenaeria acuminata* specimen was actually from Europe and inadvertently listed by Snider (1991) (Snider pers. comm.). If specimens attributed to *B. nigrinus* and *C. serratus* were even identified correctly, it is highly unlikely that they have become established; no other specimens have surfaced since Snider's publication. Consequently, we removed these latter three species and *A. cauta* from the Great Lakes species list. Snider (1991) lists several localities for *Pityohyphantes phrygianus* but does not list *P. costatus* (Hentz), which has been consistently misidentified as *P. phrygianus.* We treat the records of *P. phrygianus* as records of *P. costatus* in Table 8 and Appendix I.

The Palearctic species *Gonatium rubens* Blackwall has been recorded from Wisconsin, Illinois, and Michigan. Millidge (1981), however, stated that all North American specimens labeled '*G. rubens*' in the American Museum of Natural History were, without exception, specimens of *G. crassipalpum* Bryant. This endemic species is widely distributed on the North American continent except in the extreme southern parts. In our region of concern, the latter species has been recorded from only Illinois and Ohio. It seems a reasonable assumption that the *G. rubens* specimens from the three states were probably misidentified and that the species does not occur in North America. We removed *G. rubens* from Table 8 and Appendix I and attribute its records to *G. crassipalpum.* A similar case of misidentification applies to Great Lakes records of *Pocadicnemis pumila* (Blackwall). The species was formerly widely reported in eastern North America, but Millidge (1975) demonstrated that two closely related species, *P. americana* Millidge and *P. occidentalis* Millidge were confused with *P. pumila.* Millidge only found one *bona fide P. pumila* record from northeastern North America. Wisconsin and Michigan records of *P. pumila* before 1975 are suspect, and here we consider them to be records of *P. americana.* Unless new specimens are collected, we do not consider that it occurs in our region.

Eperigone fradeorum (Berland) is considered a cosmopolitan species; its origin is unknown. In his revision of *Eperigone,* Millidge (1987) suggested that the species "may" be endemic to the eastern seaboard (particularly Florida). He further stated that *E. fradeorum* has undergone widespread dispersal, as least partially through the agency of human travel. It appears that the species has become established in the southern portion of Illinois but has not been recorded yet in Indiana or Ohio. *Maso gallicus* Simon (Europe to Azerbaijan) and *Stemonyphantes lineatus* (Linnaeus) (Palearctic) are recorded from Wisconsin, the latter also from Michigan. There are no voucher specimens of the former species and no additional reports of the species since its listing by Levi et al. (1958). It was long believed that the American species, *S. blauveltae* Gertsch, was the same as the Palearctic species *S. lineatus*; and specimens of the former species have repeatedly been misidentified as *S. lineatus.* The Wisconsin and Michigan records of *S. lineatus* are regarded as misidentifications. *Maso gallicus* and *S. lineatus* are, consequently, removed from our updated species list (see Appendix II).

The Palearctic lycosid species, *Arctosa cinerea* (Fabricius), was recorded in 10 regions, all of which are in the state of Michigan. However, prior to 1976 (Roth & Brown 1976) when *A. littoralis* (Hentz) was removed from the synonymy of *A. cinerea,* specimens of the former species were generally misidentified as *A. cinerea.* On the Michigan list (Snider 1991) localities for both species are identical with the exception of one additional Chickering record (year not provided) of *A. cinerea* from Cheboygan County. Furthermore, voucher specimens are indicated for all *A. littoralis* localities but are lacking for the identical *A. cinerea* localities. In light of the above, we consider the records of the Palearctic species *A.*

cinerea to be instead, duplicate records of *A. littoralis.*

Ero furcata (Villers), the Palearctic mimetid species, was recorded from all five Great Lakes states. However, Kaston (1977) realized that our species was different from the Palearctic species and removed *E. leonina* (Hentz) from the synonymy of *E. furcata* with which it had been confused for so long. The native *E. leonina* is only recorded in our region from Wisconsin and Michigan. Snider (1991) commented that the Michigan record of the Palearctic species was a misidentification and referred to Kaston (1981). Therefore, we consider the records of the Palearctic species *E. furcata* as misidentifications and note that the native species occurs in all five states.

The miturgid *Cheiracanthium mildei* is listed in Platnick (2005) as Holarctic, but it is a Mediterranean native. It has spread throughout most of the eastern United States since it was first found there in 1949 (Bryant 1951), and is recorded from Illinois, Ohio, and Wisconsin in our region.

The nesticid, *Eidmannella pallida* (Emerton) is a cosmopolitan species known from Wisconsin, Illinois, Indiana (Gertsch 1984), and Ohio. Reports from the four states indicate that the species is well established. The species is known also from other northern localities in New Jersey, Massachusetts, Oregon, and Ontario, Canada. Two cosmopolitan species of the family Oecobiidae, *Oecobius cellariorum* (Dugès) and *O. navus* Blackwall are recorded from Ohio; the former species is also known from Illinois. Both species are believed to be established but appear to be restricted to indoor habitats. In the more southern regions, both species can be found both in and outside of buildings.

Records for the Palearctic philodromid species *Philodromus aureolus* (Clerck) include Illinois, Wisconsin, and Michigan. However, Dondale (1961) elevated *P. cespiticolis* Walckenaer from a subspecies of *P. aureolus.* In his publication, *P. aureolus,* referred to by Levi & Field (1954) and by Chickering (1940), was synonymized with *P. cespiticolis,* which was later placed in the synonymy of *P. cespitum* (Walckenaer) (Dondale & Redner 1976). LaSar & Unzicker (1978) listed the Palearctic species as also occurring in Illinois but there are no voucher specimens. Therefore, we regard the records of *P. aureolus* from the three states as misidentifications.

Two pholcid species, *Pholcus phalangioides* (Fuesslin) and *Spermophora senoculata* (Dugès), are recorded from the Great Lakes region; both species have apparently been introduced into the Great Lakes states. Considered a cosmopolitan species, *P. phalangioides* occurs in all five states and, throughout its range in this region, has become well established, primarily in houses and other buildings. Populations also occur in several additional northern states. *Spermophora senoculata* (Dugès) has been found in all of the Great Lakes states except Michigan. This species is listed by Platnick (2005) as Holarctic. However, it appears that within the Great Lakes region, the species has a strictly anthropochorous distribution, residing in or on houses and other buildings, and is assumed to be introduced (Huber 2000).

The Palearctic jumping spider *Evarcha falcata* (Clerck) was listed as occurring only in Michigan (Snider 1991). Because of the close similarity of *E. hoyi* and *E. falcata* and the fact that there are no voucher specimens for the Ohio record of *E. falcata,* we consider the listing of this Palearctic species as a misidentification. *Hasarius adansoni* (Audouin) is an introduced synanthropic species with known populations in several northern states including Wisconsin, Illinois, Indiana, New York, and Massachusetts (Cutler 1990). *Myrmarachne formicaria* (DeGeer) is a Palearctic species that was recorded in Ohio alone among the Great Lakes states. To our knowledge, this has been the only record of the species from the USA; and there are apparently no voucher specimens verifying the Ohio record. Therefore, we consider *M. formicaria* a doubtful record, but maintain this species for the time being as a member of the Great Lakes fauna. The Palearctic salticid species, *Phlegra fasciata* (Hahn) was recorded from Wisconsin and Michigan. However, Chickering's (1944) specimens of *P. hentzi* from Michigan were misidentified as *P. fasciata,* as were Levi & Field's (1954) specimens from Wisconsin (see Platnick 2005). The latter authors referred to *P. fasciata* as "leopard spider", *Attus leopardus* Hentz, a synonym of *P. hentzi. Phlegra hentzi* (Marx) was removed from the synonymy of *P. fasciata* by Logunov & Koponen (2002). We list *Phlegra hentzi* as a Midwest spider species and removed *Phlegra fasciata* from the Midwest spider list. *Sitticus fasciger* (Simon), possibly of Asian origin, is established in Quebec, Canada and in several states in the USA, including Wisconsin and Illinois. Platnick (2005) lists the species as occurring in Russia, China, Korea, Japan, and USA. The Zebra Jumping Spider, *Salticus scenicus* (Clerck) is listed as Holarctic in Platnick (2005), but is also apparently introduced to North America (Gertsch 1949). It is now recorded from all five states in our region.

The sicariid species, *Loxosceles rufescens* (DuFour) is considered a cosmopolitan species, and its occurrence in the USA is strictly confined to buildings (R. Vetter, pers. communication). Within the Great Lakes region, the species appears to be established in the Argus Building on the University of Michigan campus, in at least one building in the Cincinnati region of Ohio, and was collected in 2002 by the senior author in basements of buildings in downtown Chicago.

Meta menardi (Latreille), a Eurasian tetragnathid species, is reported from all Great Lakes states except Michigan. However, Marusik & Koponen (1992) recognized that within the Holarctic distribution of *M. menardi* there were three allopatric species involved, one of which occurred in North America, *M. americana* Marusik & Koponen, which Dondale (1995) synonymized with *M. ovalis* (Gertsch 1933). Consequently, the *M. menardi* records in Wisconsin, Illinois, Indiana, and Ohio were actually records of *M. ovalis* and are treated in our tables as such.

Seven introduced species in the family Theridiidae are well established in two or more of the five Great Lakes states. Three of the seven species are in the genus *Steatoda*: *S. albomaculata* (De Geer), *S. grossa* (C. L. Koch), and *S. triangulosa* (Walckenaer). *Steatoda albomaculata* and *S. triangulosa* occur in all five states, *S. grossa* is found only in Indiana and Ohio. *Achaearanea tepidariorum* (C. L. Koch) and *Theridula opulenta* (Walckenaer) are also prevalent in four of the five states (Levi & Field 1954; see discussion below under *Theridula emertoni*). *Enoplognatha ovata* (Clerck) is listed as Holarctic in Platnick (2005), but is apparently introduced to North America from Europe, as suggested by Levi (1957). Further evidence of recent introduction is that the distribution map for the species in Levi (1957) showed only four records for eastern North America, and none from our five-state region. Today, *E. ovata* is one of the most abundant species in the understory of deciduous woods throughout our region (M. Draney, pers. obs.). In light of this recent and dramatic expansion, its status as introduced is all but confirmed. Finally, *Achaearanea tabulata* Levi is also listed as Holarctic in Platnick (2005), but Dondale et al. (1994) consider it to be introduced. It is now recorded from Illinois as well as Ontario.

The 25 species that were removed from our five-state species list, either because the taxon had not become established (i.e., *Heteropoda venatoria*), or were misidentified (i.e., *Philodromus aureolus*), or constitute doubtful records (i.e., *Centromerus serratus*) are listed in our Spider Species Name Concordance Table (Appendix II).

Native species misidentifications: In light of the taxonomic advances within the past quarter century, misidentifications are often discovered when reviewing some of the older literature. Three particular species that were listed in the Great Lakes states are in question: *Crustulina guttata, Euryopis californicus*, and *Uloborus glomosus*. *Crustulina altera* was not described until 1942, and Chickering obviously recognized the difference between the species he called *guttata* in 1933 and the one he recorded as *sticta* in 1935. The abdominal colorations of *altera* and *guttata* are more alike than those of *guttata* and *sticta* (T.P. personal observation in California). By process of elimination we believe that the Chickering specimens identified as *C. guttata* were *C. altera*.

The species that Levi & Field referred to as *Euryopis californica* was, with little doubt, *E. pepini*. The Levi & Field publication was dated April 1954 and the Levi revision of *Euryopis* came out in June 1954. *Euryopis pepini* (Pepin County, Wisconsin) was described in the June issue and, of course, was not listed in Levi & Field 1954. Pepin was one of the same localities that Levi & Field stipulated for *E. californica*; also in *E. pepini* the conductor of the palp has an elbow as in *californica*, which was mentioned in the Levi & Field publication. Therefore we attribute the Wisconsin specimens of this species to *E. pepini*. Levi & Field (1954) listed *Theridula sphaerula* (now considered a synonym of the cosmopolitan *Theridula opulenta,* see above) as a member of the Wisconsin spider fauna, but identified these specimens as the native *Theridula emertoni* Levi 1954 in a later publication (Levi et al. 1958).

The salticid *Habronattus agilis,* reported by several sources for four of the five states (see Table 8 and Appendix I), represents a possible misidentification for *H. cognatus* (pers. communication B. Cutler). According to Griswold (1987), *H. agilis* is restricted to the eastern seaboard of the U.S. The records of *Pelegrina montana* reported from the Milwaukee Public Museum and by Chickering for Michigan may represent misidentifications of *P. insignis* (B. Cutler, pers. communication). The distribution for this species given by Maddison (1996) supports this assumption. *Uloborus glomosus* is the name that supplanted *U. americanus,* an unavailable name according to the rules of the ICZN; Muma & Gertsch (1964) were fairly clear on this issue in their publication.

DISCUSSION

The known spider fauna of the Great Lakes States includes 2.4% of the 38,834 known species worldwide, and 7.9% of the 3593 genera (Platnick 2005). This may seem like a tiny fraction of the world fauna unless the region's land area is taken into account: The Great Lakes states make up only about 0.5% of the world's ice-free land area. The region is actually quite diverse considering its latitude, topography and glaciation history.

Although we here report that only about 3% of the established species in the region are exotic species, we are certain this represents an underestimate of the total proportion of introduced species. Many taxa are insufficiently well known, in terms of their ecology, distribution, and systematics, to be able to evaluate their biogeographic origins with any certainty, and many simply have not been evaluated at all. Arachnological faunistic works have traditionally given scant attention to biogeographic origin, a situation which will hopefully change as arachnologists come to appreciate the critical importance of the native/non-native distinction in conservation contexts, as well as in understanding the ecology and evolution of these animals.

The known spider fauna varies among the Great Lakes states. These differences can be attributed to several environmental factors, such as climate, habitats and the varying extent of undisturbed habitats. Such factors affect the actual spider fauna present in any region at a particular point in time. Climate changes, and more recently, various and extensive habitat alterations through human activity cause faunal changes. Unfortunately, we can neither observe nor measure faunal changes, because our current lists of 'known' spider species records are not complete. Instead they reflect the varying degree of past and ongoing faunistic work in the Midwest states. Especially the low documented diversity of the Indiana spider fauna appears to be attributable to lack of collecting and research effort, as this fact has been documented in numerous faunal studies (Palmer et al. 2002). Our results above demonstrate clearly the impact of past research efforts by individual arachnologists such as Chickering for Michigan, Levi for Wisconsin and Beatty for Illinois. Ongoing faunistic studies are still being supported by a few individuals, such as Draney and Bradley for Wisconsin and Ohio.

However imperfect our current spider species lists may be, these lists are the starting point of biodiversity, biogeography, systematic and evolutionary research. In fact the generation of such species lists, taxonomically updated and available online, is demanded as an essential global resource (Knapp et al. 2005) by a variety of end-users, such as environmental agencies, governmental bodies and researchers far beyond the taxon-specialist (Steenkamp & Smith 2003). Perfecting and updating such legacy species lists is of central importance for their utility and several recent studies suggest a holistic approach, incorporating a variety of different data sources for the improvement of species lists. Current species lists and species gaps (such as we defined above) guide sampling efforts in under-sampled habitats or regions (Palmer et al. 2002). Disparate data sets from different types of surveys can be combined (Crosier & Stohlgren 2004). Bieler & Mikkelsen (2004, see above) demonstrated the value of critically analyzing grey literature, such as governmental technical reports and amateur lists, in combination with focused field work and mining museum collections.

For invertebrates and especially for arthropods, natural history collections represent a vast, yet largely untapped biodiversity information source, as it is now widely recognized e.g., by NSF initiatives such as LINNE (http://www.flmnh.ufl.edu/linne/news.htm). Whereas vertebrate collections, and to a certain degree mollusk collections are computerized, terrestrial arthropod collections lag far behind, mainly due to the sheer number of specimens in these collections. Data models and database development have come a long way (e.g., BIOTA, Ke-EMu [http://www.kesoftware.com/emu/], Specify and others). However, the main hurdle remains the enormous and as of yet unfunded task of data entry. In numerous taxon groups, we may not even know where the specimen collections are housed, e.g., see Sierwald & Reft 2004. The U.S. spider fauna is a case in point; specimens are housed in various U.S. collections, but tracing the U.S. spider fauna of a particular region is almost impossible, since none of the U.S. spider collections are computerized.

We attempted to locate spider collections containing a significant proportion of species from the Great Lakes Region. The following collections are likely to harbor at least some Midwest spider material: Field Museum of Natural History, Chicago (curator Petra Sierwald); Milwaukee Public Museum, Milwaukee (curator Joan Jass); Illinois Natural History Survey (collection manager C. Farvet); Illinois State Museum (curator E.D. Cashatt); Purdue University, Entomology Dept. (curator Arwin Provonsha); Earlham College (Leslie Bishop); Emporia State University, Emporia, KS (curator John Richard); Snow Entomological Museum, University of Kansas (collection manager Z.H. Falin); Ball State University (Gary Dodson); Entomology Museum of Michigan State University (about 5500 lots, adjunct professor Dr. R. J. Snider). Chickering's collection of Michigan spiders was deposited at the Museum of Comparative Zoology at Harvard. The University of Michigan Museum of Zoology does not contain a substantial spider collection. H.K. Wallace made a list of spiders from the George Reserve of Michigan University, but there are no voucher specimens from this study. The majority of the University of Michigan Museum's spider collection was transferred to the Florida State Collection of Arthropods, Gainesville (*fide* N. I. Platnick). Private collections: J. A. Beatty (Carbondale, Southern Illinois University); J. L. Kaspar (Oshkosh, Wisconsin); R.A. Bradley (The Ohio State University, Marion Campus); M.L. Draney (University of Wisconsin–Green Bay).

In the near future, we will continue to maintain the database and concordance table online and include documented changes submitted by users. Ultimately, this database will become more useful in more varied contexts by its planned expansion along several axes. First, species will continue to be added as we capture the remaining legacy data from published spider species lists, and as identification of newly collected and museum specimens proceeds. Clearly, we have recorded only a fraction (albeit probably a substantial fraction) of the species that occur in each of these states. Secondly, our existing database framework can be extended to adjacent states in our region, and eventually may come to encompass much or all of North America. Lastly, we plan to improve the spatial resolution of much of the data. Almost all of our data can be tracked to county level, and its input into the database can provide much finer spatial information about spider distribution across the region. The centroid location of each county can be used as a location index for many biogeographic purposes. Additionally, many of the more recent records have latitude and longitude data attached (or can be geo-referenced post-hoc with a fair degree of accuracy). Fine-scale location data on at least a subset of the recorded records can be used to address landscape-scale questions about entire assemblages of organisms. Extensive regional-scale spatial data on the complete complement of a region's species has never existed for spiders. We want to make such data publicly accessible because the potential applications of such a dataset are limited only by the imaginations of researchers.

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APPENDIX I

Literature sources and vouchers for spider species records of the five state region. S = lists the literature sources for the record, V = indicates a vouchered specimen in the Field Museum of Natural History (FMNH), the Milwaukee Public Museum (MPM), the Illinois State Museum (ISM), and the collection of the Illinois Natural History Survey (INHSC). The literature codes (e.g., BEA, Brad, c33, etc.) are given in 'Literature Cited.'

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Agelenidae									
Agelenopsis emertoni	B&N; BEA; INHSD			Brad		BJK	MPM	DR67; sni	
Agelenopsis kastoni	B&N; BEA; INHSD; L&U	INHSC		Brad					
Agelenopsis naevia	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		L&F	MPM	c32; sni	
Agelenopsis oklahoma						L&F			
Agelenopsis pennsylvanica	KBJ; BEA; INHSD	FMNH, ISM	BEA	Brad		L&F		DR67; sni	INHSC
Agelenopsis potteri	KBJ; BEA; INHSD	FMNH, ISM, INHSC				L&F	MPM	DR67; sni	
Agelenopsis utahana	KBJ; BEA; INHSD		BEA	Brad		L&F; BJK	MPM	DR67; sni; bbs	
Tegenaria domestica	KBJ; BEA; INHSD	INHSC; ISM	BEA	Brad		L&F	MPM	c34; sni	
Amaurobiidae									
Amaurobius borealis						L&F; LLK		c34; DR67; sni	
Amaurobius ferox	KBJ; BEA; INHSD		BEA	Brad			MPM	c35; sni	
Callobius bennetti	KBJ; BEA; INHSD		BEA	Brad		L&F		c32; DR67; sni; bbs	
Coras juvenilis	KBJ; BEA; INHSD		BEA	Brad				c32; c33; sni; bbs	
Coras lamellosus	KBJ; BEA; INHSD	FMNH	BEA	Brad		L&F	MPM	sni	MPM
Coras medicinalis	KBJ; BEA; INHSD	ISM	BEA	Brad				c&b; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Coras montanus				Brad		L&F		c33; DR67; sni	
Coras taugynus	B&N; BEA; INHSD								
Cybaeopsis tibialis				Brad				sni	
Wadotes calcaratus	KBJ; BEA; INHSD	FMNH	BEA	Brad	MPM	L&F		c33; DR67; sni; bbs	
Wadotes hybridus			BEA	Brad	MPM			c&b; sni	
Wadotes tennesseensis								sni	
Antrodiaetidae									
Antrodiaetus robustus				Brad					
Antrodiaetus unicolor	B&N; BEA; INHSD			Brad					
Atypoides hadros	B&N; BEA; INHSD								
Anyphaenidae									
Anyphaena celer	B&N; BEA; INHSD	FMNH	BEA	Brad		L&F; LLK; DRD		c35; c39; sni; DRD	
Anyphaena fraterna	MBC; BEA; INHSD	FMNH, ISM	BEA	Brad					
Anyphaena maculata	B&N; BEA; INHSD	FMNH							
Anyphaena pectorosa	KBJ; BEA; INHSD; L&U	FMNH, MPM, ISM	BEA	Brad		L&F	MPM	c35; c39; sni; DRD	
Arachosia cubanum	L&U; BEA; INHSD; L&U			Brad				SNA	
Hibana cambridgei	BEA								
Hibana gracilis	KBJ; BEA; INHSD; L&U	FMNH, ISM	BEA	Brad		L&F		c&b; c35; c39; DRD	
Wulfila albens	B&N; BEA; INHSD								
Wulfila saltabundus	KBJ; BEA; INHSD; L&U	FMNH, INHSC, ISM	BEA	Brad		R&R; DRD	MPM	DRE; sni; DRD	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Araneidae									
Acacesia hamata	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad				DRD	
Acanthepeira cherokee	B&N; BEA; INHSD								
Acanthepeira marion	B&N; BEA; INHSD								
Acanthepeira stellata	KBJ; BEA; INHSD; L&U	ISM, INHSC	BEA	Brad		L&F; BJK	MPM	DR67; sni	
Araneus alboventris				Brad					
Araneus bicentenarius	B&N, BEA		BEA			LLK		DRPL	
Araneus bonsallae	B&N; BEA; INHSD								
Araneus cavaticus				Brad			MPM	c32; sni	
Araneus cingulatus	B&N; BEA; INHSD	FMNH		Brad					
Araneus corticarius			BEA			L&F		c35; sni	
Araneus diadematus				Brad		L&F	MPM	DR67; sni	
Araneus gemmoides	B&N; BEA; INHSD					L&F; BJK	MPM		
Araneus guttulatus	B&N; BEA; INHSD; L&U					L&F; LLK		DRPL	
Araneus iviei								sni	MPM
Araneus juniperi	KBJ; BEA; INHSD			Brad					
Araneus marmoreus	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		L&F	MPM	c32; DR67; sni	
Araneus miniatus				Brad					
Araneus niveus	B&N; BEA; INHSD; MPM	MPM		Brad					
Araneus nordmanni				Brad		L&F		c33; DR67; sni	
Araneus partitus	B&N; BEA; INHSD			Brad					

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Araneus pegnia	KBJ; BEA; INHSD		BEA	Brad				c33; sni	
Araneus pratensis	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		L&F	MPM	c&b; sni	
Araneus saevus	KBJ; BEA; INHSD			Brad		L&F		DR67; sni	
Araneus thaddeus	KBJ; BEA; INHSD	ISM	BEA	Brad		L&F; LLK		c32; DR67; sni	
Araneus trifolium	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		L&F; BJK	MPM	c33; DR67; sni	
Araniella displicata	KBJ; BEA; INHSD; L&U	FMNH, ISM, INHSC	BEA	Brad		L&F; R&R	MPM	DR67; sni	
Argiope aurantia	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		L&F; BJK	MPM	c33; sni	
Argiope trifasciata	KBJ; BEA; INHSD; L&U	ISM, INHSC	BEA	Brad		L&F; BJK	MPM	c32; DR67; sni	
Cercidia prominens	KBJ; BEA; INHSD			Brad		L&F		c35; sni	
Cyclosa conica	KBJ; BEA; INHSD	INHSC		Brad		L&F; BJK	MPM	c32; DR67; sni	
Cyclosa turbinata	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		L&F		sni	
Eustala anastera	KBJ; BEA; INHSD	FMNH, ISM	BEA	Brad		L&F		c32; DR67; sni	
Eustala cepina	BEA	FMNH	BEA	Brad		DRPL		DRPL	
Eustala emertoni	BEA			Brad					
Gea heptagon	KBJ; BEA; INHSD	ISM, INHSC		Brad				sni	
Hypsosinga funebris	B&N; BEA; INHSD			Brad					
Hypsosinga pygmaea	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		LLK; BJK		c32; sni	
Hypsosinga rubens	KBJ; BEA; INHSD		BEA	Brad				c32; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Larinia borealis	KBJ; BEA; INHSD			Brad		L&F; LLK		c&b; DR67; sni	
Larinia directa				Brad					
Larinioides cornutus	KBJ; BEA; INHSD	FMNH, ISM	BEA	Brad		L&F	MPM	c32; DR67; sni	
Larinioides patagiatus	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F	MPM	c32; DR67; sni	
Larinioides sclopetarius	KBJ; BEA; INHSD	INHSC	BEA	Brad		DRPL	MPM	c&b; DR67; sni	
Mangora gibberosa	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		L&F; BJK	MPM	c33; DR67; sni	
Mangora maculata	KBJ; BEA; INHSD	FMNH, ISM, INHSC	BEA	Brad				sni	
Mangora placida	KBJ; BEA; INHSD	FMNH, ISM, INHSC	BEA	Brad	INHSC	L&F; BJK	MPM	sni	
Mastophora bisaccata	B&N; BEA; INHSD		BEA	Brad				c35; sni	
Mastophora cornigera			BEA						
Mastophora hutchinsoni	KBJ; BEA; INHSD		DRPL	Brad					
Mastophora phrynosoma	B&N; BEA; INHSD								
Metazygia calix	B&N; BEA; INHSD	ISM, INHSC		Brad					
Metepeira labyrinthea	KBJ; BEA; INHSD	ISM	BEA	Brad		L&F		c32; sni	
Metepeira palustris						L&F			
Micrathena gracilis	BEA; INHSD	FMNH, ISM, INHSC	BEA	Brad		L&F		sni	
Micrathena mitrata	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		L&F	MPM		
Micrathena sagittata	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		L&F	MPM	sni	MPM
Neoscona arabesca	KBJ; BEA; INHSD; L&U; MBC	ISM, INHSC	BEA	Brad		L&F; BJK	MPM	c32; DR67; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Neoscona crucifera	KBJ; BEA	ISM	BEA	Brad			MPM	DRPL	
Neoscona domiciliorum	B&N; BEA; INHSD	ISM, INHSC	BEA	Brad			MPM		
Neoscona oaxacensis			BEA						
Neoscona pratensis	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		L&F		c35	
Ocrepeira ectypa	BEA	ISM		Brad					
Ocrepeira georgia				Brad					
Singa eugeni	BEA			Brad		BJK	MPM		
Singa keyserlingi	B&N; BEA; INHSD	ISM		Brad		LLK			
Verrucosa arenata	KBJ; BEA; INHSD	INHSC; ISM	BEA	Brad		L&F	MPM		
Zygiella montana						L&F	MPM	c34; sni	
Zygiella nearctica								DR67; sni	MPM
Atypidae									
Sphodros atlanticus	G&P; BEA; INHSD								
Sphodros coylei				Brad					
Sphodros niger	KBJ; BEA; INHSD		BEA	Brad		L&F; LLK			
Sphodros rufipes	G&P; BEA; INHSD	INHSC		Brad				sni	
Clubionidae									
Clubiona abboti	KBJ; INHSD; BEA; L&U	ISM, INHSC	BEA	Brad	MPM	L&F; BJK; DRD	MPM	c32; c39; sni; bbs; DRD	
Clubiona bishopi		FMNH							
Clubiona bryantae	B&N; INHSD							c39; sni; DRD	
Clubiona canadensis				Brad		L&F; LLK; DRD	MPM	c32; c39; DR67; sni; DRD	
Clubiona catawba	B&N; INHSD			Brad				DRD	
Clubiona chippewa						L&F; DRD		DR67; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Clubiona johnsoni	KBJ; BEA; INHSD	FMNH, ISM, INHSC		Brad		BJK; R&R	MPM	DRD; sni	
Clubiona kastoni	B&N; BEA; INHSD	FMNH		Brad		L&F; LLK; BJK	MPM	DRD; sni; DRD	
Clubiona kiowa								DRE; DRD	
Clubiona kulczynskii								sni	
Clubiona maritima	KBJ; BEA; INHSD	ISM	BEA	Brad		DRD; BJK	MPM	c&b; c39; sni; DRD	
Clubiona mixta		INHSC		Brad		L&F; LLK; DRD; BJK	MPM	c39; DR67; sni; DRD	
Clubiona moesta	B&N; BEA; INHSD					L&F; DRD	MPM	c33; c39; DR67; sni	
Clubiona norvegica		FMNH							
Clubiona obesa	KBJ; BEA; INHSD	FMNH, ISM, INHSC	BEA	Brad		L&F; DRD	MPM	c32; c39; DR67; sni; DRD	MPM
Clubiona pikei		INHSC		Brad					
Clubiona pygmaea	MBC; BEA; INHSD	FMNH	BEA	Brad		L&F		c39; sni; DRD	
Clubiona quebecana						DRD			
Clubiona rileyi			BEA						
Clubiona riparia	BEA; INHSD		BEA	Brad		L&F; BJK	MPM	c32; c34; c39; DR67; sni; DRD	
Clubiona saltitans	KBJ; BEA; INHSD								
Clubiona spiralis				Brad					
Clubiona trivialis						LLK; DRD		c39; DR67; sni	
Elaver excepta	KBJ; BEA; INHSD	FMNH, ISM	BEA	Brad		L&F; DRD		c33; DR67; sni	
Corinnidae									
Castianeira alata	BEA								
Castianeira amoena	B&N; BEA; INHSD								

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Castianeira cingulata	KBJ; BEA; INHSD	FMNH, INHSC	BEA	Brad		L&F; DRD	MPM	c32; c39; DR67; sni; bbs; DRD	
Castianeira crocata	B&N; BEA; INHSD		BEA						
Castianeira descripta	KBJ; BEA; INHSD; L&U	ISM, INHSC	BEA	Brad		L&F; DRD	MPM	c33; c39; DR67; sni; DRD	
Castianeira gertschi	MBC; BEA; INHSD	FMNH, INHSC		Brad				DRD; sni; DRD	
Castianeira longipalpa	KBJ; BEA; INHSD	FMNH, ISM, INHSC	BEA	Brad	MPM	L&F		c33; c39; sni; DRD	
Castianeira trilineata	KBJ; BEA; INHSD	FMNH	BEA	Brad	MPM	L&F; BJK; DRD	MPM	DRD; sni	
Castianeira variata	B&N; BEA; INHSD			Brad	MPM			sni	
Meriola decepta	KBJ; BEA; INHSD	INHSC	BEA	Brad				DRD	
Myrmecotypus lineatus								sni	
Phrurolithus concisus				Brad					
Phrurolithus emertoni	KBJ; BEA; INHSD								
Phrurolithus goodnighti	KBJ; BEA; INHSD								
Phrurolithus similis	B&N, KBJ; BEA; INHSD		BEA					sni	
Phruronellus formica	KBJ; BEA; INHSD								
Phruronellus formidabilis								c39; sni	
Phrurotimpus alarius	KBJ; BEA; INHSD	FMNH; INHSC	BEA	Brad	MPM	L&F; BJK; DRD		c32; c39; DR67; sni; bbs	
Phrurotimpus borealis	KBJ; BEA; INHSD	FMNH; INHSC	BEA	Brad	MPM	L&F; LLK; R&R		c39; DR67; sni; bbs	
Phrurotimpus certus		INHSC							
Phrurotimpus dulcineus		FMNH							
Phrurotimpus illudens	B&N; BEA; INHSD								

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Phrurotimpus minutus	BEA; INHSD		BEA	Brad		R&R			
Scotinella britcheri	B&N; BEA; INHSD	INHSC	BEA	Brad					
Scotinella brittoni		FMNH		Brad				sni	
Scotinella deleta		FMNH							
Scotinella divesta		FMNH						sni	
Scotinella fratrella	BEA	FMNH		Brad					
Scotinella madisonia		FMNH		Brad		L&F; LLK; DRD			
Scotinella manitou						L&F			
Scotinella minnetonka						L&F; LLK			
Scotinella pugnata	KBJ; BEA; INHSD	FMNH; INHSC		Brad				c33; sni	
Scotinella redempta	KBJ; BEA; INHSD			Brad					
Trachelas tranquillus	KBJ; BEA; INHSD	FMNH, INHSC, ISM	BEA	Brad		L&F; DRD	MPM	c&b; c39; sni; DRD	
Ctenidae									
Anahita punctulata	B&N; BEA; INHSD		BEA	Brad					
Ctenizidae									
Ummidia tuobita	KBJ; BEA; INHSD								
Cybaeidae									
Cybaeota calcarata								sni; c35	
Cybaeus giganteus	B&N; BEA; INHSD			Brad					
Dictynidae									
Argenna obesa	B&N; BEA; INHSD; L&U	FMNH, INHSC		Brad		L&F			
Cicurina arcuata	BEA	FMNH, INHSC	BEA	Brad	MPM	L&F; LLK		c35; DR67; sni	
Cicurina brevis	INHSD	FMNH, ISM, INHSC	BEA	Brad		L&F		c34; DR67; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Cicurina cavealis	BEA		BEA						
Cicurina itasca						L&F			
Cicurina ludoviciana	KBJ; BEA; INHSD		BEA						
Cicurina minima		FMNH	BEA						
Cicurina minnesota		FMNH	BEA					sni	
Cicurina pallida	KBJ; BEA; INHSD; NSE; L&U	INHSC	BEA	Brad				c35; sni	
Cicurina placida	KBJ; BEA; INHSD		BEA			L&F		DR67; sni; bbs	
Cicurina robusta	KBJ; INHSD	ISM, INHSC	BEA	Brad		LLK		sni; bbs	
Dictyna arundinacea								sni	
Dictyna bellans	BEA			Brad				sni	
Dictyna bostoniensis	KBJ; BEA; INHSD		BEA	Brad		L&F; LLK	MPM	DR67; sni	
Dictyna brevitarsa				Brad				DR67; sni	
Dictyna coloradensis	B&N; BEA; INHSD		BEA			L&F; BJK; R&R	MPM	DR67; sni	
Dictyna foliacea	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		L&F:BJK	MPM	c33; c35; DR67; sni	
Dictyna formidolosa	B&N; BEA; INHSD		BEA	Brad					
Dictyna longispina	KBJ; BEA; INHSD			Brad		L&F			
Dictyna minuta	KBJ; BEA; INHSD	FMNH	BEA	Brad		L&F; LLK		DR67; sni	
Dictyna sancta						L&F		DR67; sni	
Dictyna terrestris								SNA	
Dictyna volucripes	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		BJK	MPM	c33; DR67; sni	
Emblyna altamira								sni	
Emblyna angulata	BEA		BEA						
Emblyna annulipes	KBJ; BEA; INHSD	ISM	BEA	Brad		L&F		DR67; sni	
Emblyna consulta								SNA	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Emblyna cruciata	B&N; BEA; INHSD		BEA	Brad		L&F		sni	
Emblyna decaprini				Brad					
Emblyna hentzi	B&N; BEA; INHSD	INHSC		Brad		L&F; LLK		sni	
Emblyna manitoba	KBJ; BEA; INHSD					L&F			
Emblyna maxima								DR67; sni	
Emblyna phylax						SNA			
Emblyna roscida				Brad				sni	
Emblyna sublata	KBJ; BEA; INHSD	FMNH; ISM; INHSC	BEA	Brad		L&F; BJK	MPM	c32; DR67; sni	
Emblyna zaba				Brad					
Iviella ohioensis				Brad					
Lathys foxi			BEA	Brad		L&F; LLK; BJK	MPM	c34; DR67; sni	
Lathys immaculata	B&N; BEA; INHSD								
Lathys maculina			BEA						
Lathys pallida			BEA	Brad		L&F; LLK		c34; DR67; sni	
Phantyna bicornis	KBJ; BEA; INHSD		BEA	Brad		L&F		sni	
Phantyna pixi								SNA	
Dysderidae									
Dysdera crocata	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F	MPM		
Gnaphosidae									
Callilepis imbecilla	KBJ; BEA; INHSD; p&d		BEA; p&d	Brad		L&F; R&R		bbs	
Callilepis pluto	B&N; BEA; INHSD	FMNH, INHSC		Brad		p&d		sni; p&d	
Cesonia bilineata	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad		L&F; LLK; p&d		c35; sni; p&d	
Drassodes auriculoides				Brad		L&F; LLK; p&d		sni; p&d	
Drassodes gosiutus				Brad; p&d				p&d	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Drassodes neglectus	KBJ; BEA; INHSD		BEA			L&F; p&d		c32; DR67; sni; p&d	
Drassodes saccatus	KBJ; BEA	INHSC						p&d	
Drassyllus aprilinus	KBJ; BEA; INHSD	FMNH	BEA	Brad				bbs; p&d	
Drassyllus covensis	B&N; BEA; INHSD								
Drassyllus creolus	B&N; BEA; INHSD	INHSC	BEA	Brad				p&d	
Drassyllus depressus	KBJ; BEA; INHSD; L&U	INHSC	BEA	Brad		L&F		c33; sni; bbs	
Drassyllus dixinus	BEA								
Drassyllus eremitus	KBJ; BEA; INHSD			Brad		LLK; p&d		p&d	
Drassyllus eremophilus								p&d	
Drassyllus fallens	B&N; BEA; INHSD	INHSC		Brad		L&F; p&d		p&d	
Drassyllus frigidus	B&N; BEA; INHSD			Brad				p&d	
Drassyllus gynosaphes								sni	
Drassyllus lepidus	BEA								
Drassyllus nannellus				Brad					
Drassyllus niger	BEA	FMNH				L&F; LLK; p&d		c34; DR67; sni; p&d	
Drassyllus novus	KBJ; BEA; INHSD	FMNH	BEA	Brad		L&F; p&d		bbs; p&d	
Drassyllus rufulus	BEA	INHSC	BEA	Brad		L&F; LLK; p&d		p&d	
Gnaphosa brumalis								c33; sni	
Gnaphosa fontinalis	B&N; BEA; INHSD			Brad		L&F; LLK; p&d			
Gnaphosa muscorum						L&F; p&d	MPM	c32; DR67; sni; p&d	
Gnaphosa parvula		FMNH; INHSC	BEA	Brad; p&d		p&d	MPM	c34; sni; bbs; p&d	
Gnaphosa sericata	KBJ; BEA; INHSD; L&U		BEA	Brad		L&F; p&d; R&R		sni; p&d	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Haplodrassus bicornis	B&N; BEA; INHSD		BEA	Brad		L&F; p&d		c34; sni; bbs; p&d	
Haplodrassus hiemalis		FMNH		Brad		L&F; LLK; p&d		sni; p&d	
Haplodrassus mimus	KBJ; BEA; INHSD								
Haplodrassus signifer	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F; p&d; R&R		c&b; DR67; sni; bbs; p&d	
Herpyllus ecclesiasticus	KBJ; BEA; INHSD	FMNH; ISM; INHSC	BEA	Brad	INHSC	L&F; p&d; BJK	MPM	c32; DR67; sni; p&d	
Litopyllus temporarius	B&N; BEA; INHSD		BEA	Brad				p&d	
Micaria elizabethae		FMNH; INHSC	BEA; p&d	Brad				p&d	
Micaria emertoni								DR67; sni; p&d	
Micaria gertschi		FMNH		Brad				DR67; p&d	
Micaria laticeps	B&N; BEA; INHSD							c35	
Micaria longipes	KBJ; BEA; INHSD	INHSC		Brad		L&F; LLK	MPM	p&d; DR67; sni	
Micaria longispina						L&F		p&d	
Micaria pulicaria	KBJ; BEA; INHSD	FMNH; INHSC		Brad		L&F; LLK	MPM	c35; sni; bbs	
Micaria riggsi		FMNH		Brad		p&d		p&d	
Nodocion floridanus			BEA			L&F; LLK; p&d			
Sergiolus bicolor				Brad				p&d	
Sergiolus capulatus	KBJ; BEA; INHSD; L&U	FMNH; ISM; INHSC	BEA	Brad		L&F; p&d; BJK; R&R;	MPM	sni; p&d	
Sergiolus decoratus	BEA	INHSC		Brad				sni	
Sergiolus lowelli				Brad					
Sergiolus minutus	BEA					L&F			
Sergiolus montanus	BEA		BEA	Brad		L&F; p&d		c&b; sni; p&d	
Sergiolus ocellatus	BEA	FMNH; INHSC		Brad		p&d		p&d	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Sergiolus tennesseensis	BEA	INHSC	BEA					p&d	
Sergiolus unimaculatus								p&d	
Sosticus insularis	KBJ; BEA; INHSD	FMNH	BEA	Brad		L&F; LLK; p&d		sni; p&d	
Sosticus loricatus	KBJ; BEA; INHSD					L&F; p&d			
Synaphosus paludis	BEA								
Talanites echinus				Brad					
Talanites exlineae	B&N; BEA; INHSD								
Urozelotes rusticus	KBJ; BEA; INHSD			Brad		LLK; p&d			
Zelotes duplex	B&N; BEA; INHSD		BEA; p&d	Brad; p&d				p&d	
Zelotes exiguoides		FMNH							
Zelotes fratris	BEA; KBJ; INHSD	FMNH; INHSC	BEA	Brad		L&F; p&d		c34; DR67; sni; bbs; p&d	
Zelotes hentzi	KBJ; BEA; INHSD	FMNH	BEA	Brad		L&F; p&d; BJK; R&R	MPM	sni; p&d	
Zelotes laccus	L&U; BEA; INHSD; L&U		BEA	Brad					
Zelotes puritanus						L&F; p&d		c34; sni	
Hahniidae									
Antistea brunnea	B&N; BEA; INHSD					LLK		c63; sni	
Calymmaria cavicola	B&N; BEA; INHSD	INHSC	BEA	Brad					
Cryphoeca montana				Brad				DR67; sni	
Hahnia cinerea	KBJ; BEA; INHSD	FMNH; INHSC	BEA	Brad	MPM	L&F; LLK	INHSC	c34; c63; sni	
Hahnia flaviceps	B&N; BEA; INHSD	INHSC		Brad					
Neoantistea agilis	KBJ; BEA; INHSD; L&U		BEA	Brad	MPM	L&F; LLK		c32; c63; DR67; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Neoantistea magna	KBJ; BEA; INHSD	FMNH; INHSC	BEA	Brad		R&R		sni; bbs	
Neoantistea riparia					MPM	L&F		c63; DR67	
Linyphiidae									
Agyneta olivacea								c35	
Allomengea dentisetis						SNA			
Baryphyma longitarsum						L&F		sni	
Baryphyma trifrons affine				Brad					
Bathyphantes alboventris	KBJ; BEA; INHSD	FMNH		Brad		L&F			
Bathyphantes brevis				Brad		L&F		c35; sni	
Bathyphantes canadensis				Brad					
Bathyphantes pallidus	KBJ; BEA	FMNH; INHSC	BEA	Brad		L&F; LLK		DR67; sni	
Bathyphantes weyeri			BEA	Brad		LLK			
Blestia sarcocuon				Brad					
Centromerus cornupalpis	KBJ; BEA; INHSD	FMNH; INHSC	BEA	Brad		LLK		c35; DR67; sni	
Centromerus denticulatus								sni	
Centromerus latidens	KBJ; BEA; INHSD	FMNH; INHSC	BEA	Brad				DR67; sni	
Centromerus longibulbus								sni	
Centromerus persolutus						L&F; BJK	MPM	c35; DR67; sni	
Centromerus sylvaticus		FMNH		Brad		L&F; BJK	MPM	sni	
Centromerus tennapex				Brad					
Ceraticelus alticeps		FMNH						DR67; sni	
Ceraticelus atriceps	KBJ; BEA; INHSD			Brad		L&F; LLK		c35; DR67; sni	
Ceraticelus bryantae				Brad					
Ceraticelus bulbosus	KBJ; BEA; INHSD			Brad				sni	
Ceraticelus carinatus				Brad					
Ceraticelus creolus	B&N; BEA; INHSD								

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Ceraticelus emertoni	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F; R&R		DR67; sni	
Ceraticelus fissiceps	KBJ; BEA; INHSD	FMNH	BEA	Brad		L&F; BJK	MPM	c33; DR67; sni	
Ceraticelus laetabilis	KBJ; BEA; INHSD					L&F; LLK		DR67; sni	
Ceraticelus laetus	KBJ; BEA; INHSD	FMNH	BEA			L&F; LLK		sni	
Ceraticelus laticeps	KBJ; BEA; INHSD					R&R		sni	
Ceraticelus limnologicus	KBJ; BEA; INHSD		BEA						
Ceraticelus micropalpis	B&N; BEA; INHSD							sni	
Ceraticelus minutus	B&N; BEA; INHSD	INHSC	BEA	Brad		L&F; LLK		DR67; sni	
Ceraticelus paschalis				Brad					
Ceraticelus pygmaeus		INHSC		Brad				sni	
Ceraticelus similis	KBJ; BEA; INHSD			Brad		LLK			
Ceratinella brunnea	KBJ; BEA; INHSD	FMNH	BEA	Brad		L&F; LLK		c35; DR67; sni	
Ceratinops annulipes		FMNH				L&F			
Ceratinops crenatus		INHSC		Brad		L&F; LLK; R&R		sni	
Ceratinops latus				Brad		L&F			
Ceratinops rugosus	KBJ; BEA; INHSD; L&U		BEA	Brad		L&F; LLK	MPM		
Ceratinopsidis formosa	B&N; BEA; INHSD			Brad		L&F			
Ceratinopsis atolma	B&N; INHSD			Brad					
Ceratinopsis auriculata		FMNH				L&F			
Ceratinopsis interpres			BEA	Brad				sni	
Ceratinopsis laticeps	B&N; BEA; INHSD; L&U; L&U			Brad					

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Ceratinopsis nigriceps	L&U; BEA; INHSD			Brad		L&F		DR67; sni	
Ceratinopsis nigripalpis	BEA			Brad					
Ceratinopsis sutoris	KBJ; BEA; INHSD								
Ceratinopsis xanthippe	KBJ; BEA; INHSD			Brad					
Ceratinopsis yola	KBJ; BEA; INHSD								
Cheniseo fabulosa		FMNH							
Collinsia oxypaederoptipus			BEA	Brad				DR67; sni	
Collinsia plumosa	BEA; KBJ; INHSD; L&U	FMNH	BEA	Brad		LLK		sni	
Collinsia probata			BEA						
Dicymbium elongatum				Brad					
Diplocentria bidentata	KBJ; BEA; INHSD								
Diplocephalus cristatus	KBJ; BEA					L&F			
Diplocephalus subrostratus						LLK		sni	
Diplostyla concolor	KBJ; BEA; INHSD	FMNH	BEA	Brad		L&F	MPM	sni	
Disembolus corneliae			SNA						
Dismodicus decemoculatus	KBJ; BEA	FMNH	BEA	Brad		L&F; LLK; BJK	MPM	sni	
Drapetisca alteranda				Brad		L&F		c33; DR67; sni	
Eperigone antraea	BEA								
Eperigone augustalis	BEA					LLK			
Eperigone bryantae		FMNH							
Eperigone entomologica								sni	
Eperigone eschatologica	BEA								
Eperigone fradeorum	AM; BEA; INHSD	FMNH							
Eperigone index						L&F; LLK			
Eperigone maculata	KBJ; BEA; INHSD	FMNH; INHSC		Brad		L&F		c35; DR67; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Eperigone tridentata	KBJ; BEA; INHSD; L&U	FMNH; INHSC	BEA	Brad		LLK		sni	
Eperigone trilobata	KBJ; BEA; INHSD; L&U	FMNH; INHSC		Brad		L&F		DR67; sni	
Eperigone undulata	BEA		BEA						
Epiceraticelus fluvialis				Brad					
Eridantes erigonoides	KBJ; BEA; INHSD	FMNH, INHSC	BEA	Brad		L&F		sni	
Eridantes utibilis	KBJ; BEA; INHSD	FMNH	BEA	Brad		LLK			
Erigone aletris			BEA						
Erigone alsaida						LLK		DR67; sni	
Erigone atra	KBJ; BEA; INHSD; L&U		BEA	Brad		L&F; LLK		DR67; sni	
Erigone autumnalis	KBJ; BEA; INHSD; L&U	FMNH; INHSC	BEA	Brad				sni	
Erigone blaesa	KBJ; BEA; INHSD		BEA	Brad		L&F; LLK		sni	
Erigone dentigera	KBJ; BEA; INHSD		BEA	Brad		L&F		DR67; sni	
Erigone infernalis	BEA		BEA						
Erigone praecursa		FMNH							
Erigone zographica								sni	
Estrandia grandaeva				Brad					
Floricomus bishopi				Brad					
Floricomus plumalis	KBJ; BEA; INHSD					L&F		DR67; sni	
Floricomus rostratus	B&N; BEA; INHSD			Brad					
Florinda coccinea	KBJ; BEA; INHSD	INHSC	BEA	Brad					
Frontinella communis	KBJ; BEA; L&U	ISM; INHSC	BEA	Brad		L&F; BJK		c32; DR67; sni	MPM
Gnathonaroides pedalis		FMNH				L&F			
Gonatium crassipalpum	B&N; BEA; INHSD			Brad		L&F; LLK		c34; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Goneatara nasutus				Brad					
Goneatara plathyrinus	BEA			Brad					
Grammonota gentilis				Brad		LLK	MPM	DR67; sni	
Grammonota gigas		FMNH						sni	
Grammonota inornata	B&N; BEA; INHSD; L&U		BEA	Brad				sni	
Grammonota ornata				Brad				sni	
Grammonota pictilis	B&N; BEA; INHSD	INHSC		Brad		L&F		DR67; sni	
Grammonota vittata				Brad		L&F			
Graphomoa theridioides	BEA								
Helophora insignis				Brad		L&F; R&R		c33; DR67; sni	
Hybauchenidium cymbadentatum						L&F; LLK			
Hypomma marxi								SNA	
Hypselistes florens	KBJ; BEA; INHSD	FMNH; INHSC	BEA	Brad		L&F; BJK; R&R	MPM	c&b; c35; sni	
Idionella formosa				Brad				sni	
Idionella rugosa		INHSC						sni	
Idionella sclerata	FMNH	FMNH						sni	
Incestophantes calcaratus								sni	
Incestophantes duplicatus								sni	
Islandiana flaveola	KBJ; BEA; INHSD	FMNH		Brad				sni	
Islandiana flavoides		FMNH							
Islandiana longisetosa	KBJ; BEA; INHSD		BEA	Brad				sni	
Islandiana speophila				Brad					
Kaestneria pullata		FMNH				L&F; LLK; BJK	MPM	sni	
Lepthyphantes intricatus						SNA			
Lepthyphantes leprosus		INHSC		Brad		L&F	MPM	sni	
Lepthyphantes minutus								c&b; sni	
Lepthyphantes turbatrix				Brad		L&F		DR67; sni	
Macrargus multesimus				Brad		LLK		DR67; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Maso sundevalli						LLK		DR67; sni	
Megalepthyphantes nebulosus	KBJ; BEA; INHSD		BEA	Brad		L&F; R&R	MPM	DR67; sni	
Meioneta angulata				Brad				sni	
Meioneta barrowsi		FMNH		Brad					
Meioneta brevipes				Brad					
Meioneta evadens	KBJ; BEA; INHSD	FMNH							
Meioneta fabra	L&U; BEA; INHSD; L&U	FMNH; INHSC	BEA	Brad				sni	
Meioneta leucophora		FMNH							
Meioneta micaria	KBJ; BEA; INHSD; L&U	FMNH	BEA	Brad					
Meioneta officiosa				Brad					
Meioneta serrata								sni	
Meioneta simplex		FMNH						sni	
Meioneta unimaculata	KBJ; BEA; INHSD; L&U	FMNH, INHSC	BEA	Brad		LLK; R&R		sni	
Meioneta zygia		FMNH							
Microlinyphia pusilla	L&U			Brad				c32; sni	
Microlinyphia impigra		FMNH		Brad					
Microlinyphia mandibulata	KBJ; BEA; INHSD	FMNH, ISM; INHSC	BEA	Brad		L&F; LLK		c32; DR67; sni	
Microneta viaria	KBJ; BEA; INHSD	FMNH		Brad		L&F; LLK; R&R		c35; DR67; sni	
Mythoplastoides exiguus			BEA						
Neriene clathrata	KBJ; BEA	FMNH; INHSC	BEA	Brad		BJK; L&F; BJK; R&R	MPM	c33; DR67; sni	
Neriene radiata	KBJ; BEA; INHSD	FMNH, ISM; INHSC	BEA	Brad		L&F; BJK	MPM	c32; DR67; sni	
Neriene variabilis	KBJ; BEA; INHSD	FMNH, ISM; INHSC	BEA	Brad		L&F	MPM	c33; sni	
Oedothorax maximus				Brad					
Oedothorax montifer			BEA						
Oedothorax trilobatus		INHSC				L&F; LLK		sni	
Oreonetides rotundus								SNA	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Oreonetides vaginatus								DR67; sni	
Origanates rostratus	KBJ; BEA; INHSD		BEA	Brad		L&F; LLK		sni	
Paracornicularia bicapillata	B&N; BEA; INHSD								
Pelecopsis bishopi			BEA					sni	
Pelecopsis moesta				Brad				DR67; sni	
Phanetta subterranea	B&N; BEA; INHSD; NSE		BEA						
Pityohyphantes costatus	KBJ; BEA; INHSD	FMNH; ISM	BEA	Brad		L&F; BJK	MPM	c32; DR67	
Pityohyphantes limitaneus								sni	
Pocadicnemus americana		FMNH; INHSC				LLK		DR67; sni	
Poeciloneta bihamata								sni	
Poeciloneta furcata						L&F			
Poeciloneta theridiformis		INHSC							
Porrhomma cavernicola	BEA; NSE		BEA						
Porrhomma terrestre		FMNH		Brad		L&F; LLK		DR67; sni	
Satilatlas arenarius	BEA; INHSD			Brad		L&F		sni	
Sciastes acuminatus		FMNH				LLK			
Sciastes truncatus						LLK			
Scirites pectinatus		FMNH				LLK			
Scironis tarsalis		FMNH						DR67; sni	
Scotinotylus pallidus								DR67; sni	
Scotinotylus vernalis								SNA	
Scylaceus pallidus	KBJ; BEA; INHSD	FMNH	BEA	Brad		L&F; LLK; R&R		sni	
Scyletria jona		FMNH							
Sisicottus montanus								DR67; sni	
Sisicottus montigenus								DR67; sni	
Sisicus penifusifer						L&F; LLK		DR67; sni	
Sitalcas ruralis		FMNH							
Souessa spinifera						L&F	MPM		
Souessoula parva	KBJ; BEA; INHSD	FMNH							

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Sougambus bostoniensis						L&F			
Soulgas corticarius		FMNH				L&F; LLK		sni	
Stemonyphantes blauveltae	KBJ; BEA; INHSD		BEA	Brad					
Styloctetor purpurescens	B&N; BEA; INHSD			Brad		L&F			
Tapinocyba emertoni				Brad					
Tapinocyba hortensis				Brad					
Tapinocyba minuta						LLK		DR67; sni	
Tapinocyba scopulifera	L&U; BEA; INHSD; L&U							sni	
Tapinocyba simplex						L&F; LLK		DR67; sni	
Tapinocyba sucra				Brad					
Tapinopa bilineata	B&N; BEA; INHSD			Brad		L&F		c33; sni	
Taranucnus ornithes				Brad					
Tennesseellum formica	KBJ; BEA; INHSD; L&U	INHSC	BEA	Brad		L&F; LLK		sni	
Tenuiphantes sabulosus	B&N; BEA; INHSD	FMNH; INHSC		Brad		L&F		sni; DR67	
Tenuiphantes zebra	BEA	FMNH	BEA	Brad		L&F; LLK		sni	
Thyreosthenius parasiticus				Brad		L&F			
Tmeticus ornatus	KBJ; BEA; INHSD					L&F		sni	
Traematosisis bispinosis								sni	
Tunagyna debilis						L&F		c35; DR67; sni	
Tusukuru hartlandianus								DR67; sni	
Tutaibo anglicanus	KBJ; BEA; INHSD		BEA						
Walckenaeria atrotibialis		FMNH				MIL		MIL	
Walckenaeria auranticeps								MIL	
Walckenaeria brevicornis	KBJ; BEA; INHSD	FMNH		Brad		LLK		sni; MIL	
Walckenaeria castanea		FMNH		Brad		L&F		DR67; sni	
Walckenaeria clavicornis				Brad		L&F		DR67; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Walckenaeria communis	BEA	FMNH		Brad		L&F; LLK; MIL		sni; MIL	
Walckenaeria digitata		FMNH							
Walckenaeria directa	KBJ; BEA; INHSD; MIL	FMNH		Brad		MIL		c35; sni; MIL	
Walckenaeria exigua						MIL		MIL	
Walckenaeria indirecta	KBJ; BEA; INHSD					L&F		DR67; sni	
Walckenaeria minuta		FMNH	BEA	Brad		L&F; LLK; MIL		DR67; sni; MIL	
Walckenaeria pallida		FMNH		Brad; MIL		L&F; LLK; MIL		c35; DR67; sni; MIL	
Walckenaeria palustris		FMNH							
Walckenaeria pinocchio								sni	
Walckenaeria redneri						MIL			
Walckenaeria spiralis	KBJ; BEA; INHSD; L&U; MIL	FMNH; INHSC	MIL	Brad		L&F; LLK; R&R		DR67; sni; MIL	
Walckenaeria subdirecta	KBJ; BEA; INHSD; MIL	FMNH	BEA					MIL	
Walckenaeria subpallida	MIL								
Walckenaeria tibialis				Brad				sni; MIL	
Wubana drassoides		FMNH		Brad					
Liocranidae									
Agroeca minuta	KBJ; BEA		BEA	Brad					
Agroeca ornata	BEA	FMNH				L&F		c34; c39; DR67; sni; bbs; DRD	
Agroeca pratensis			BEA	Brad		L&F; LLK		c34; c39; DR67; sni	
Lycosidae									
Allocosa funerea	KBJ; BEA; INHSD	FMNH, ISM	BEA	Brad				DRE; sni?; bbs	
Allocosa georgicola	B&N; BEA; INHSD		BEA					DRE; c35; sni	
Allocosa noctuabunda			BEA						

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Allocosa sublata			BEA						
Alopecosa aculeata				Brad		L&F; DRE		c33; DR67; sni; DRE	
Alopecosa kochi								c35; sni; DRE	
Arctosa emertoni	KBJ; BEA; INHSD		BEA			L&F; LLK; DRE; R&R	MPM	DRE; sni	
Arctosa littoralis	KBJ; BEA; INHSD		BEA	Brad		L&F; LLK; DRE	MPM	DR67; sni; DRE	
Arctosa raptor								sni	
Arctosa rubicunda			BEA	Brad		L&F; LLK; DRE		DRE; sni	
Arctosa virgo				Brad				DRE	
Geolycosa fatifera								c33	
Geolycosa missouriensis	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F; LLK		DR67; sni; DRE	
Geolycosa pikei								c33; sni	
Geolycosa sepulchralis				SNA					
Geolycosa turricola				Brad				c34	
Geolycosa wrighti	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad		LLK	MPM	DR67; sni; DRE	INHSC
Gladicosa bellamyi				Brad					
Gladicosa gulosa	KBJ; BEA; INHSD; DRE	FMNH, ISM	BEA; DRE	Brad		L&F; DRE	MPM	c32; sni; bbs; DRE	
Gladicosa pulchra	B&N; BEA; INHSD			Brad					
Hogna aspersa	KBJ; BEA; INHSD	ISM	BEA	Brad		L&F	MPM	c34; DRE	
Hogna baltimoriana	KBJ; BEA; INHSD; DRE	INHSC	BEA	Brad		L&F; DRE		DR67; DRE	
Hogna carolinensis	KBJ; BEA; INHSD	FMNH, ISM; INHSC	BEA	Brad		L&F		c32; DRE	
Hogna frondicola	KBJ; BEA; INHSD	FMNH, ISM; INHSC	BEA	Brad		L&F; BJK; R&R	MPM	c32; DR67; bbs; DRE	
Hogna helluo	KBJ; BEA; INHSD	FMNH, ISM; INHSC	BEA	Brad		L&F	MPM	c33; DR67; sni; DRE	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Hogna lenta				SNA					
Hogna permunda	SNA								
Pardosa distincta	KBJ; BEA; INHSD	FMNH; INHSC		Brad		L&F; BJK; R&R	MPM	c32; DR67; sni; DRE; w81	
Pardosa fuscula	BEA		BEA			L&F; LLK; DRE	MPM	c35; DR67; sni; DRE; w81	
Pardosa glacialis				Brad				sni	
Pardosa groenlandica						L&F; DRE		c35; sni; DRE; w81	
Pardosa hyperborea								w81; sni; DRE	
Pardosa lapidicina	B&N; BEA; INHSD	ISM; INHSC	BEA	Brad		L&F; LLK		DR67; sni; DRE; w81	
Pardosa littoralis								sni	
Pardosa mackenziana						L&F; DRE		c34; DR67; sni; DRE; w81	
Pardosa milvina	KBJ; BEA; INHSD; L&U	FMNH; ISM; INHSC	BEA; DRE	Brad; DRE		L&F; DRE	MPM	c32; DR67; sni; bbs; DRE; w81	
Pardosa modica	KBJ; BEA; INHSD	FMNH; INHSC	BEA	Brad		L&F	MPM	c34; c35; DR67; sni; bbs; DRE; w81	
Pardosa moesta	KBJ; BEA; INHSD	FMNH; INHSC	BEA	Brad		L&F; BJK	MPM	c32; DR67; sni; bbs; w81	
Pardosa saxatilis	KBJ; BEA; INHSD; DRE	FMNH, ISM; INHSC		Brad; DRE	MPM	L&F; DRE	MPM	c33; DR67; sni; bbs; DRE; w81	
Pardosa sternalis								sni	
Pardosa xerampelina	KBJ; BEA; INHSD	ISM	BEA	Brad		L&F	MPM	c32; DR67; sni; w81	MPM
Pirata alachuus	B&N; BEA; INHSD		BEA	Brad					
Pirata apalacheus	W&E; BEA; INHSD		BEA						

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Pirata aspirans	KBJ; BEA; INHSD; DRE	INHSC	DRE	Brad; DRE		L&F; DRE	MPM	c32; DR67; sni; DRE	
Pirata cantralli							MPM	DRE	
Pirata giganteus	KBJ; BEA; INHSD; DRE	FMNH				DRE			
Pirata indigenus							MPM		
Pirata insularis	KBJ; BEA; INHSD	FMNH; ISM; INHSC	BEA	Brad		L&F; BJK	MPM	c33; c35; sni	
Pirata minutus	KBJ; BEA; INHSD	FMNH; INHSC	BEA	Brad	MPM	L&F; R&R	MPM	c33; DR67; sni; bbs; DRE	
Pirata montanoides	W&E; BEA; INHSD; DRE							DRE	
Pirata montanus	KBJ; BEA; INHSD		BEA	Brad		L&F; BJK	MPM	c33; DR67; sni; bbs	
Pirata piraticus	KBJ; BEA; INHSD	FMNH	BEA	Brad			MPM	c32; DR67; sni	
Pirata sedentarius	MBC; BEA; INHSD	ISM; INHSC	BEA	Brad; DRE		L&F; DRE	MPM	c35; sni; DRE	
Pirata seminolus								DRE	
Pirata spiniger	B&N; BEA; INHSD								
Pirata sylvanus	W&E; BEA; INHSD								
Pirata triens	W&E; BEA; INHSD	FMNH							
Pirata zelotes	W&E; BEA; INHSD; DRE	INHSC		Brad		DRE	MPM	DRE	
Rabidosa hentzi	B&N; BEA; INHSD								
Rabidosa punctulata	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad	MPM			c35; DRE	
Rabidosa rabida	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad	MPM			DRE	
Schizocosa aulonia	BEA		BEA						
Schizocosa avida	KBJ; BEA; INHSD	FMNH; ISM; INHSC	BEA	Brad; DRE		L&F; R&R		c32; DR67; sni; DRE	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Schizocosa bilineata	KBJ; BEA; INHSD	FMNH; ISM; INHSC	BEA	Brad; DRE	MPM	L&F; DRE		c35; sni; bbs; DRE	
Schizocosa crassipalpata	BEA; DRE	FMNH; INHSC	BEA	Brad		L&F; BJK; R&R	MPM	DRE; sni; bbs; DRE	
Schizocosa crassipes		INHSC			MPM	L&F		c32	
Schizocosa duplex				Brad				DRE; bbs; DRE	
Schizocosa mccooki	BEA	FMNH				DRE	MPM	DRE	
Schizocosa ocreata	KBJ; BEA; INHSD; DRE	FMNH; ISM; INHSC	BEA; DRE	Brad; DRE		BJK; DRE; BJK	MPM	DRE; sni; bbs; DRE	
Schizocosa retrorsa	KBJ; BEA; INHSD; DRE	FMNH; INHSC		Brad; DRE					
Schizocosa rovneri	U&D; BEA; INHSD	INHSC		Brad; DRE					
Schizocosa saltatrix	KBJ; BEA; INHSD; DRE	FMNH; ISM; INHSC	BEA; DRE	Brad; DRE	MPM	L&F; DRE; R&R		c&b; sni; DRE	
Schizocosa stridulans	GS; BEA; INHSD			Brad; DRE					
Trabeops aurantiacus		FMNH	BEA	Brad; DRE		L&F; DRE		DRE	
Trebacosa marxi	KBJ; BEA; INHSD		BEA	Brad; DRE				DR67; sni; DRE	
Trochosa ruricola		FMNH							
Trochosa terricola	KBJ; BEA; INHSD; DRE	FMNH; INHSC	BEA; DRE	Brad; DRE		L&F; BJK; DRE; R&R	MPM	c33; DR67; sni; bbs; DRE	
Varacosa avara	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad	MPM	L&F; DRE	MPM	c35; sni; DRE	
Varacosa shenandoa	BEA; DRE	INHSC							
Mimetidae									
Ero canionis				Brad		LLK			
Ero leonina	B&N; BEA; INHSD	FMNH	BEA	Brad		L&F		c35; DR67; sni	
Mimetus epeiroides	B&N; BEA; INHSD; L&U		BEA	Brad		L&F	MPM	DR67; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Mimetus nelsoni			Brad						
Mimetus notius	KBJ; BEA; INHSD	FMNH; INHSC				L&F; LLK			
Mimetus puritanus	B&N; BEA; INHSD	INHSC	BEA	Brad	INHSC	L&F		sni	
Mimetus syllepsicus				Brad				c35; sni	
Miturgidae									
Cheiracanthium inclusum	KBJ; BEA; INHSD; L&U	ISM	BEA	Brad				DRD; DRE; sni	
Cheiracanthium mildei	B&N; BEA; INHSD; MPM; L&U	MPM, ISM, INHSC		Brad			MPM		
Strotarchus piscatorius	B&N; BEA; INHSD			Brad					
Mysmenidae									
Maymena ambita	B&N; BEA; INHSD			Brad					
Microdipoena guttata	B&N; BEA; INHSD			Brad					
Nesticidae									
Eidmannella pallida	KBJ; BEA; INHSD; NSE	FMNH; INHSC		Brad		L&F			
Nesticus bishopi			SNA						
Nesticus carteri			BEA						
Oecobiidae									
Oecobius cellariorum	MBC; BEA; INHSD			Brad					
Oecobius navus				Brad					
Oonopidae									
Orchestina saltitans	B&N; BEA; INHSD			Brad				sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Oxyopidae									
Oxyopes aglossus	B&N; BEA; INHSD								
Oxyopes salticus	KBJ; BEA; INHSD; L&U	ISM; INHSC	BEA	Brad; DRE		L&F; BJK; DRE	MPM	c&b; sni; DRE	
Oxyopes scalaris	MBC; BEA; INHSD; L&U	ISM		Brad		L&F; LLK; DRE		DRE; sni	
Philodromidae									
Ebo iviei								DRC; sni	
Ebo latithorax	KBJ; BEA; INHSD		BEA	Brad		LLK		c35; c40; DR67; sni	
Ebo pepinensis	KBJ; BEA; INHSD		BEA					sni	
Philodromus alascensis	KBJ; BEA; INHSD		BEA					sni	
Philodromus bimuricatus	B&N; BEA; INHSD								
Philodromus cespitum	KBJ; BEA; INHSD; DRB; L&U	INHSC	BEA; DRB	Brad; DRB		L&F; DRB; BJK	MPM	c34; c40; DR67; DRB	
Philodromus exilis						DRA		c35; c40	
Philodromus histrio						DRC		c35; sni; DRC	
Philodromus imbecillus	KBJ; BEA; DRA; INHSD	FMNH; INHSC	BEA	Brad		L&F; DRA		c&b; c40; DR67; sni; DRA	
Philodromus infuscatus	B&N; BEA; INHSD			Brad		L&F; LLK		c35; c40; DR67; sni; DRC	
Philodromus keyserlingi	B&N; BEA; INHSD; DRB; L&U	FMNH	BEA; DRB	Brad		DRB		sni	
Philodromus marxi	KBJ; BEA; INHSD; DRA	FMNH; ISM; INHSC	BEA; DRA	Brad		L&F; DRA; DRC		c35; c40; sni; DRA	
Philodromus mineri								c35; c40; sni; DRA; DRC	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Philodromus minutus	B&N; BEA; INHSD		BEA; DRA	Brad; DRA		DRA		c33; sni; DRA; DRC	
Philodromus montanus	B&N; BEA; INHSD								
Philodromus oneida	B&N; BEA; INHSD; DRA					L&F; DRA		DRA	
Philodromus peninsulanus								DRA	
Philodromus pernix		INHSC				L&F	MPM	c32; c40; DR67; sni	
Philodromus placidus	B&N; BEA; INHSD; DRA	ISM	BEA; DRA	Brad; DRA		L&F	MPM	DR67; sni; DRA	
Philodromus praelustris	B&N; BEA; INHSD		BEA; DRB			DRB		sni	
Philodromus pratariae	B&N; BEA; INHSD								
Philodromus rufus	KBJ; BEA; INHSD	FMNH	BEA	Brad		L&F	MPM	c34; c40; DR67; sni	
Philodromus rufus quartus								DRA	
Philodromus rufus vibrans		FMNH				BJK		DRA	
Philodromus satullus				Brad; DRA		L&F; LLK; DRA		c35; c40; sni	
Philodromus vulgaris	KBJ; BEA; INHSD	ISM, INHSC	BEA; DRB	Brad; DRB		DRB		sni	
Thanatus coloradensis								c32; sni	
Thanatus formicinus	KBJ; BEA; INHSD; L&U	INHSC	BEA	Brad		L&F; R&R	MPM	c40; DR67; sni	MPM
Thanatus rubicellus	B&N; BEA; INHSD	FMNH						sni	INHSC
Thanatus striatus		INHSC					MPM	sni	
Thanatus vulgaris				Brad					
Tibellus duttoni	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad				c40; sni	
Tibellus maritimus	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F; BJK; R&R	MPM	c&b; c40; DR67; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Tibellus oblongus	KBJ; BEA; INHSD; L&U	ISM; INHSC	BEA	Brad		L&F; BJK; R&R	MPM	c32; c40; DR67; sni	
Pholcidae									
Pholcus phalangioides	KBJ; BEA; INHSD; NSE	ISM; INHSC	BEA	Brad		L&F; LLK; BJK	MPM	c&b; sni	
Spermophora senoculata	B&N; BEA; INHSD	INHSC	BEA	Brad		L&F			
Pisauridae									
Dolomedes albineus	B&N; BEA; INHSD								
Dolomedes scriptus	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad; DRE		L&F; DRE	MPM; INHSC	c35; DR67; sni; DRE	
Dolomedes striatus	KBJ; BEA; INHSD; DRE	FMNH; INHSC	BEA	Brad		L&F; BJK	MPM	DRE; sni; DRE	
Dolomedes tenebrosus	BEA; INHSD; DRE	FMNH; ISM; INHSC	BEA; DRE	Brad; DRE		L&F; BJK	MPM; INHSC	DR67; c35; sni; DRE	
Dolomedes triton	KBJ; BEA; INHSD; DRE	ISM; INHSC	BEA; DRE	Brad		L&F; BJK; DRE	MPM	c32; c33; c35; DR67; sni; DRE	
Dolomedes vittatus	KBJ; BEA; INHSD; NSE	ISM; INHSC	BEA	Brad				c&b; sni	
Pisaurina brevipes	KBJ; BEA; INHSD; DRE; L&U	INHSC	BEA	Brad; DRE				c&b; sni; DRE	
Pisaurina dubia	B&N; BEA; INHSD			Brad					
Pisaurina mira	KBJ; BEA; INHSD; DRE; L&U	FMNH; ISM; INHSC	BEA; DRE	Brad		L&F; BJK; DRE	MPM	c32; sni; bbs; DRE	
Pisaurina undulata	BEA; INHSD		BEA						
Salticidae									
Admestina tibialis	KBJ; BEA; INHSD		BEA	Brad		L&F	INHSC	c44; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Admestina wheeleri						SNA		SNA	
Agassa cyaena	KBJ; BEA; INHSD; L&U	ISM	BEA	Brad					
Attidops youngi	B&N; BEA; INHSD	INHSC		Brad		L&F	MPM		
Eris aurantia	KBJ; BEA; INHSD; NSE	ISM; INHSC	BEA	Brad	INHSC				
Eris flava	BEA; INHSD					BJK			
Eris floridana				Brad					
Eris militaris	BEA	ISM	BEA	Brad		BJK		c33	
Eris pinea	L&U; BEA; INHSD; L&U		BEA	Brad					
Euophrys monadnock				Brad		LLK			
Evarcha hoyi	KBJ; BEA; INHSD	FMNH; INHSC	BEA	Brad		L&F; BJK; R&R		c33; DR67; c44	
Ghelna barrowsi				Brad					
Ghelna canadensis	KBJ; BEA; INHSD; NSE	FMNH; INHSC	BEA	Brad		L&F		c44; sni	
Chinattus parvulus	KBJ; BEA; INHSD	FMNH		Brad		LLK			
Habronattus agilis	KBJ; BEA; INHSD	INHSC	BEA	Brad				c34; c44; DR67; sni	
Habronattus borealis	KBJ; BEA; INHSD		BEA	Brad		L&F		c34; c44; DR67; sni	
Habronattus calcaratus	KBJ; BEA; INHSD		BEA	Brad				DR67; sni	
Habronattus captiosus						SNA		SNA	
Habronattus coecatus	MBC; BEA; INHSD	INHSC		Brad				sni	
Habronattus cognatus	BEA		BEA	Brad				sni	
Habronattus conjunctus	KBJ; INHSD								
Habronattus decorus	B&N; BEA; INHSD	INHSC		Brad		L&F; LLK; R&R		c34; c44; sni	
Habronattus orbus				Brad					

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Habronattus texanus	L&U; BEA; INHSD; L&U			Brad				sni	
Habronattus viridipes	KBJ; BEA; INHSD	INHSC		Brad		L&F		c34; c44; sni	
Hasarius adansoni	KBJ; BEA; INHSD		BEA			L&F			
Hentzia mitrata	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad		L&F		c44; sni	
Hentzia palmarum	KBJ; BEA; INHSD; NSE; L&U	ISM; INHSC	BEA	Brad	INHSC	L&F	MPM	c&b; c33; c44; DR67; sni	
Maevia inclemens	KBJ; BEA; INHSD	FMNH, ISM; INHSC	BEA	Brad		L&F; BJK	MPM	c&b; sni; bbs	
Marpissa bina	KBJ	INHSC				L&F		c44; sni	
Marpissa dentoides				Brad					
Marpissa formosa	BEA		BEA	Brad		BJK	MPM	sni	
Marpissa grata	KBJ; BEA; INHSD					BJK	MPM	w84	
Marpissa lineata	KBJ; BEA; INHSD; NSE	FMNH; ISM; INHSC	BEA	Brad		L&F; R&R	MPM	c44; sni; bbs	
Marpissa pikei	KBJ; BEA; INHSD; NSE	ISM; INHSC	BEA	Brad		L&F	MPM	w84	
Metacyrba taeniola	MBC; BEA; INHSD					L&F			
Myrmarachne formicaria				Brad					
Naphrys pulex	KBJ; BEA; INHSD; NSE	FMNH, ISM	BEA	Brad		L&F; R&R	MPM	c33; c44; DR67; sni; bbs	
Neon ellamae						SNA			
Neon nelli	KBJ; BEA; INHSD; NSE	FMNH; INHSC		Brad		L&F		c&b; c44; DR67; sni; bbs	
Neon plutonus		FMNH							
Paradamoetas fontanus						L&F			
Peckhamia americana	MBC; BEA; INHSD		BEA	Brad					

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Peckhamia picata	BEA	INHSC		Brad		L&F	MPM	c44; sni	
Peckhamia scorpionia				Brad				c44	
Pelegrina chalceola	BEA								
Pelegrina exigua	BEA			Brad					
Pelegrina flaviceps							MPM		
Pelegrina flavipes	KBJ; BEA	INHSC	BEA			L&F		c34; DR67; sni	
Pelegrina galathea	KBJ; BEA; L&U	FMNH; ISM; INHSC	BEA	Brad		BJK	MPM	w84; sni	
Pelegrina insignis	KBJ; BEA	INHSC	BEA	Brad		L&F	MPM	w84; sni	
Pelegrina montana							MPM	c&b	
Pelegrina peckhamorum				Brad					
Pelegrina proterva	KBJ; BEA; L&U	FMNH; ISM; INHSC	BEA	Brad		BJK; L&F; R&R	MPM	c32; c34; DR67; sni	INHSC
Pellenes longimanus								sni	
Phidippus apacheanus						L&F; LLK			
Phidippus audax	KBJ; BEA; INHSD; NSE; L&U	ISM; INHSC	BEA	Brad		L&F; BJK	MPM	c&b; c44; sni	
Phidippus borealis						L&F		c33	
Phidippus cardinalis	KBJ; B&N; BEA; INHSD	INHSC; ISM	BEA	Brad			MPM	c34	
Phidippus clarus	KBJ; BEA; INHSD; NSE; MPM	MPM; ISM; INHSC	BEA	Brad		L&F; BJK	MPM	c32; c44; DR67; sni	INHSC
Phidippus insignarius	BEA	INHSC		Brad			MPM	c44; sni	
Phidippus mystaceus	KBJ; BEA; INHSD			Brad				c35	
Phidippus pius	B&N; BEA; INHSD			Brad				c44; sni	
Phidippus princeps	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F		c44; sni	
Phidippus purpuratus		ISM; INHSC	BEA	Brad		L&F	MPM	c33; c44; DR67; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Phidippus putnami	B&N; BEA; INHSD	INHSC	BEA	Brad					
Phidippus whitmani	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F; LLK; BJK		c33; c44; sni; bbs	
Phlegra hentzi	B&N; BEA	INHSC	BEA	Brad		L&F; LLK		c&b; c44; sni	
Platycryptus undatus	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad	INHSC	L&F	MPM	c&b; DR67; sni	
Salticus scenicus	KBJ; BEA; INHSD; NSE	ISM; INHSC	BEA	Brad		L&F; BJK	MPM	c&b; c44; DR67; sni	
Sarinda hentzi	MBC; BEA; INHSD	INHSC		Brad					
Sassacus papenhoei	B&N; BEA; INHSD	ISM; INHSC		Brad		L&F	MPM		
Sibianor aemulus						L&F			
Sitticus concolor	B&N; KBJ; BEA, INHSD	FMNH; INHSC				R&R			
Sitticus dorsatus		INHSC							
Sitticus fasciger	B&N; INHSD					PRO; BJK			
Sitticus floricola palustris	KBJ; BEA; INHSD; NSE	ISM; INHSC	BEA	Brad		L&F; BJK	MPM	c33; c44; DR67; sni	
Sitticus striatus						L&F	MPM		
Synageles canadensis								SNA	
Synageles noxiosus	KBJ; BEA; INHSD; NSE	INHSC		Brad		L&F; BJK		sni	
Synageles occidentalis	MBC; BEA; INHSD					BJK, R&R			
Synemosyna formica	KBJ; BEA; INHSD; NSE	ISM; INHSC	BEA	Brad		L&F; BJK		c44; sni	
Talavera minuta	KBJ; BEA; INHSD; NSE	FMNH	BEA	Brad		R&R		sni; bbs	
Thiodina puerpera		ISM; INHSC		Brad					
Thiodina sylvana	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad					
Tutelina elegans	KBJ; BEA; INHSD; NSE; L&U	MPM; ISM; INHSC	BEA	Brad		L&F; LLK		c33; c44; DR67; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Tutelina formicaria	KBJ; BEA; INHSD	INHSC		Brad				c33; c44; sni	
Tutelina harti	KBJ; BEA; INHSD; NSE		BEA	Brad		L&F	MPM	c&b; c44; sni	
Tutelina similis	KBJ; BEA; INHSD; NSE	FMNH	BEA	Brad		L&F; BJK	MPM	c&b; c44; DR67; sni	
Zygoballus nervosus	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad		L&F; LLK	MPM	c&b; c44; sni	
Zygoballus rufipes	KBJ; BEA; INHSD	FMNH; ISM; INHSC	BEA	Brad		L&F; LLK; BJK	MPM	c&b; sni	
Zygoballus sexpunctatus	B&N; BEA; INHSD	ISM		Brad					
Scytodidae									
Scytodes thoracica	B&N; BEA; INHSD	INHSC	BEA	Brad		L&F	MPM	c&b; sni	
Segestriidae									
Ariadna bicolor	B&N; BEA; INHSD		BEA	Brad					
Sicariidae									
Loxosceles reclusa	B&N; BEA; INHSD	ISM; INHSC	BEA	Brad					
Loxosceles rufescens	B&N; BEA; INHSD	FMNH		Brad					
Tengellidae									
Liocranoides tennesseensis				Brad					
Tetragnathidae									
Dolichognatha pentagona	B&N; BEA; INHSD								
Tetragnathidae									
Glenognatha foxi	KBJ; BEA; INHSD; L&U; LEV	FMNH; INHSC	BEA; LEV	Brad; LEV		L&F; LEV			

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Leucauge venusta	BEA; INHSD; LEV	FMNH, ISM	BEA; LEV	Brad; LEV		L&F; LLK; LEV; BJK	MPM	c32; DR67; sni; LEV	
Meta ovalis	KBJ; BEA; INHSD; LEV	ISM	BEA; LEV	Brad; LEV		L&F; LEV	MPM		
Metellina curtisi						LEV			
Pachygnatha autumnalis	BEA; LEV	FMNH; INHSC		Brad; LEV	MPM			sni; LEV	
Pachygnatha brevis	B&N; BEA; INHSD; LEV		BEA; LEV	Brad				c&b; sni	
Pachygnatha dorothea	BEA; LEV			Brad; LEV		L&F; LLK; LEV; BJK; R&R	MPM	DR67; sni; LEV	
Pachygnatha furcillata			BEA; LEV	Brad					
Pachygnatha tristriata	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad; LEV	MPM	LLK; LEV		sni	
Pachygnatha xanthostoma	KBJ; BEA; INHSD		BEA; LEV	Brad; LEV		LEV		sni; LEV	MPM
Tetragnatha caudata	KBJ; BEA; INHSD	ISM	BEA	Brad		L&F; BJK	MPM	c&b; c59; sni	
Tetragnatha dearmata		ISM				L&F; LLK		c59; DR67; sni	MPM
Tetragnatha elongata	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad		L&F	MPM	c32; c59; sni	
Tetragnatha extensa			BEA					c32; c59; DR67; sni	MPM
Tetragnatha guatemalensis	B&N; BEA; INHSD		BEA	Brad		L&F; R&R		c59; DR67; sni	
Tetragnatha laboriosa	KBJ; BEA; INHSD; L&U	ISM; INHSC	BEA	Brad		L&F; BJK	MPM	c32; c59; DR67; sni	INHSC
Tetragnatha pallescens	KBJ; BEA; INHSD	ISM	BEA	Brad		L&F	MPM	c&b; c59; DR67; sni	
Tetragnatha shoshone	BEA			Brad					
Tetragnatha straminea	KBJ; BEA; INHSD; L&U	ISM; INHSC	BEA	Brad		L&F		c32; c59; sni	MPM

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Tetragnatha vermiformis	BEA	INHSC	BEA			L&F	MPM	c&b; c59; sni	
Tetragnatha versicolor	KBJ; BEA; INHSD	ISM, INHSC	BEA	Brad		L&F	MPM	c59; DR67; sni	
Tetragnatha viridis								sni	
Theridiidae									
Achaearanea conjuncta				Brad					
Achaearanea globosa	KBJ; BEA; INHSD	FMNH		Brad		L&F; LLK	MPM	c35; sni	
Achaearanea porteri	B&N; BEA; INHSD		BEA	Brad					
Achaearanea rupicola	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F; LLK			
Achaearanea tabulata		FMNH							
Achaearanea tepidariorum	KBJ; BEA; INHSD; NSE	ISM; INHSC	BEA	Brad	MPM	L&F; LLK	MPM	c32; DR67; sni	
Anelosimus studiosus	BEA							sni	
Argyrodes elevatus	B&N; BEA; INHSD								
Crustulina altera	KBJ; BEA; INHSD	FMNH	BEA	Brad		L&F; LLK; R&R	MPM	c33; sni	MPM; INHSC
Crustulina sticta	KBJ; BEA; INHSD		BEA	Brad		LLK; R&R	MPM	c35; DR67; sni	
Dipoena buccalis				Brad				sni	
Dipoena nigra	KBJ; BEA; INHSD	FMNH, ISM		Brad		L&F; LLK		DR67; sni	INHSC
Enoplognatha caricis	B&N; BEA; INHSD	FMNH		Brad		L&F; LLK; BJK	MPM	sni	
Enoplognatha intrepida	KBJ; INHSD					L&F; LLK		sni	
Enoplognatha joshua	B&N; BEA; INHSD								
Enoplognatha marmorata	KBJ; BEA; INHSD		BEA	Brad		L&F; LLK	MPM	c32; DR67; sni	
Enoplognatha ovata		FMNH		Brad		BJK	MPM	sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Episinus amoenus				Brad					
Euryopis argentea	KBJ; BEA; INHSD		BEA	Brad		L&F; LLK		sni	
Euryopis funebris	KBJ; BEA	FMNH, ISM; INHSC	BEA	Brad		L&F; LLK	MPM	c&b; DR67; sni	
Euryopis gertschi	KBJ; BEA; INHSD		BEA						
Euryopis pepini				Brad		L&F; LLK			
Euryopis quinquemaculata	B&N; BEA; INHSD			Brad					
Euryopis saukea						L&F; LLK			
Faiditus cancellatus	B&N; BEA; INHSD			Brad					
Keijia alabamensis	B&N; BEA; INHSD		BEA	Brad		L&F; LLK			
Keijia antoni	B&N; BEA; INHSD			Brad					
Keijia punctosparsa	KBJ; BEA; INHSD		BEA	Brad		MPM	MPM	c32; sni	
Lasaeola prona	B&N; BEA; INHSD	FMNH							
Latrodectus mactans	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad			MPM	c33	
Latrodectus variolus	B&N; BEA; INHSD	INHSC	BEA	Brad		L&F; LLK	MPM	sni	
Neospintharus trigonum	B&N; BEA; INHSD	FMNH, ISM	BEA	Brad		L&F; LLK		c33; DR67; sni	MPM
Pholcomma hirsutum	BEA		BEA	Brad		L&F; LLK			
Phoroncidia americana	B&N; BEA; INHSD		BEA	Brad				sni	
Robertus banksi						L&F; LLK			
Robertus borealis								SNA	
Robertus eremophilus	KBJ; BEA; INHSD	FMNH				L&F; LLK			
Robertus frontatus	B&N; BEA; INHSD	FMNH		Brad					

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Robertus fuscus						LLK		c35; sni	
Robertus laticeps	KBJ; BEA; INHSD					LLK		DR67; sni	
Robertus longipalpus		FMNH				L&F; LLK			
Robertus pumilis			SNA						
Robertus riparius	KBJ; BEA; INHSD		BEA	Brad		L&F; LLK; BJK	MPM	DR67; sni	
Robertus similis								sni	
Robertus spinifer						LLK		sni	
Rhomphaea fictilium	B&N; BEA; INHSD	INHSC		Brad					
Rugathodes aurantius						LLK		sni	
Rugathodes sexpunctatus				Brad		L&F; LLK		c34; DR67; sni	
Spintharus flavidus	KBJ; BEA; INHSD	ISM		Brad					
Steatoda albomaculata	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F; LLK		DR67; sni	
Steatoda americana	KBJ; BEA; INHSD		BEA	Brad		L&F; LLK	MPM	c34; sni	
Steatoda borealis	KBJ; BEA; INHSD; MPM	FMNH; MPM; ISM; INHSC	BEA	Brad	MPM	L&F; LLK	MPM; INHSC	c32; DR67; sni	MPM
Steatoda grossa			BEA	Brad					
Steatoda triangulosa	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad		L&F; LLK	MPM	sni	MPM
Stemmops ornatus	B&N; BEA; INHSD			Brad					
Takayus lyricus	B&N; BEA; INHSD	FMNH	BEA	Brad		L&F; LLK	MPM	sni	
Theonoe stridula						L&F; LLK		sni	
Theridion albidum	B&N; BEA; INHSD; L&U	FMNH; INHSC	BEA	Brad		L&F; LLK; BJK	MPM	sni	
Theridion cheimatos				SNA					

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Theridion differens	KBJ; BEA; INHSD		BEA	Brad		L&F; LLK; BJK	MPM	c34; DR67; sni	
Theridion dividuum						R&R			
Theridion flavonotatum	B&N; BEA; INHSD			Brad					
Theridion frondeum	KBJ; BEA; INHSD; L&U	FMNH; ISM; INHSC	BEA	Brad		L&F; LLK; BJK; R&R	MPM	c32; DR67; sni	
Theridion glaucescens	KBJ; BEA; INHSD		BEA	Brad		L&F; LLK	MPM	c32; DR67; sni	
Theridion hemerobium	B&N; BEA; INHSD			Brad		L&F; LLK	MPM	sni	
Theridion llano	B&N; BEA; INHSD								
Theridion montanum								c34; sni	
Theridion murarium	KBJ; BEA; INHSD		BEA	Brad		L&F; LLK	MPM	c&b; DR67; sni	MPM
Theridion neshamini	B&N; BEA; INHSD; L&U			Brad					
Theridion pennsylvanicum	KBJ; BEA; INHSD	FMNH	BEA	Brad					
Theridion petraeum								DR67; sni	
Theridion pictipes	B&N; BEA; INHSD	FMNH		Brad					
Theridion pictum	KBJ; BEA; INHSD	ISM	BEA			L&F; LLK	MPM	c32; DR67; sni	
Theridion rabuni	L&U; BEA; INHSD; L&U								
Theridula emertoni		ISM		Brad		L&F; LLK		DR67; sni	
Theridula opulenta	KBJ; BEA; INHSD; L&U	ISM; INHSC	BEA	Brad				c33; sni	
Thymoites marxi				Brad					
Thymoites pallidus	B&N; BEA; INHSD		BEA						
Thymoites unimaculatus	KBJ; BEA; INHSD; L&U	INHSC	BEA	Brad		BJK; L&F; LLK	MPM	sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Wamba crispulus	B&N; BEA; INHSD	FMNH		Brad					
Theridiosomatidae									
Theridiosoma gemmosum	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F; BJK	MPM	c32; sni	
Thomisidae									
Bassaniana floridana				Brad					
Bassaniana utahensis		FMNH					MPM	sni	
Bassaniana versicolor	KBJ; BEA; INHSD	FMNH	BEA	Brad		L&F	MPM	c&b; c40; DRC	
Misumena vatia	KBJ; BEA; INHSD; L&U	ISM	BEA	Brad		L&F; BJK	MPM	c32; c40; DR67; sni	MPM
Misumenoides formosipes	KBJ; BEA; INHSD; L&U	MPM; ISM; INHSC	BEA	Brad		L&F	MPM	c&b	
Misumenops asperatus	KBJ; BEA; INHSD; L&U	ISM; INHSC	BEA	Brad		L&F; BJK	MPM	c32; c40; sni	
Misumenops celer	KBJ; BEA; INHSD	ISM; INHSC		Brad				sni	
Misumenops oblongus	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad		L&F	MPM	c35; c40; DR67; sni	
Ozyptila americana	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F; LLK; BJK		c33; c40; DR67; sni; bbs	
Ozyptila conspurcata	KBJ; BEA; INHSD	FMNH; INHSC	BEA			L&F; R&R		c&b; c40; sni; bbs	
Ozyptila creola				Brad					
Ozyptila curvata				Brad					
Ozyptila distans								sni	
Ozyptila georgiana		FMNH; INHSC						sni	
Ozyptila modesta				Brad		L&F			
Ozyptila monroensis	KBJ; BEA; INHSD	FMNH	BEA	Brad		LLK; DRC		DRE; DRC	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Synema parvulum	MBC; BEA; INHSD	ISM; INHSC	BEA	Brad					
Tmarus angulatus	KBJ; BEA; INHSD	FMNH; ISM; INHSC	BEA	Brad		L&F		c35; c40; sni	
Tmarus minutus				Brad					
Tmarus rubromaculatus			BEA						
Xysticus alboniger		INHSC		Brad				sni	
Xysticus ampullatus						BJK		sni	
Xysticus auctificus	L&U; BEA; INHSD	ISM	BEA	Brad			MPM	sni	
Xysticus banksi	KBJ; BEA; INHSD		BEA					DRE; c&b; sni	
Xysticus bicuspis	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F; LLK; R&R		c&b; c40; sni; DRC	
Xysticus canadensis								sni	
Xysticus chippewa								sni	
Xysticus cunctator		FMNH							
Xysticus discursans	KBJ; BEA; INHSD	FMNH; ISM; INHSC	BEA	Brad	MPM	R&R	MPM	c&b; c40; sni	
Xysticus elegans	KBJ; BEA; INHSD; L&U	FMNH; ISM	BEA	Brad		L&F; BJK	MPM	c&b; c40; DR67; sni; bbs	
Xysticus ellipticus								sni	
Xysticus emertoni	KBJ; BEA; INHSD	FMNH		Brad		L&F; BJK	MPM	c33; sni	
Xysticus ferox	KBJ; BEA; INHSD; L&U	FMNH; MPM; INHSC; ISM	BEA	Brad	MPM	L&F; BJK	MPM	c32; c40; DR67; sni; bbs	
Xysticus fervidus		FMNH							
Xysticus fraternus	KBJ; BEA; INHSD; L&U	FMNH	BEA	Brad		L&F; BJK	MPM	c35; c40; sni; bbs	
Xysticus funestus	KBJ; BEA; INHSD	ISM	BEA	Brad		L&F		c&b; c40; sni	
Xysticus gulosus	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F		c&b; c40; DR67; sni	

APPENDIX I—Continued.

Species	Illinois S	Illinois V	Indiana S	Ohio S	Ohio V	Wisconsin S	Wisconsin V	Michigan S	Michigan V
Xysticus luctans	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad		L&F; R&R	MPM	DR67; sni	
Xysticus luctuosus						L&F; LLK		sni	
Xysticus nevadensis						LLK			
Xysticus pellax		INHSC		Brad		L&F; R&R		DR67; sni	
Xysticus posti								DRE; DRC	
Xysticus punctatus						LLK; DRC	MPM	sni	
Xysticus texanus	B&N; BEA; INHSD		BEA						
Xysticus triguttatus	KBJ; BEA; INHSD	ISM; INHSC	BEA	Brad		L&F; BJK; R&R	MPM	c34; c40; DR67; sni	
Titanoecidae									
Titanoeca americana	KBJ; BEA; INHSD	INHSC	BEA	Brad		L&F	MPM	c&b; DR67; sni	
Titanoeca brunnea	BEA		BEA	Brad					
Uloboridae									
Hyptiotes cavatus	KBJ; BEA; INHSD	FMNH; INHSC	BEA	Brad		L&F; LLK		c32; DR67; sni	
Octonoba sinensis	MBC; BEA; INHSD	ISM	BEA	Brad					
Uloborus glomosus	KBJ; BEA; INHSD; L&U	FMNH; ISM; INHSC	BEA	Brad		L&F		sni	
Zoridae									
Zora pumila	B&N; BEA; INHSD	INHSC	BEA	Brad					

APPENDIX II

Spider Species Name Concordance Table. The table contains all species names and genus-species name combinations employed in the referenced species lists (Literature cited). The literature source is listed in the column Source, using the abbreviations listed in the Literature cited section. The column 'Reason for exclusion' indicates the currently valid name under which the particular species is listed in Table 8 and Appendix I. Abbreviations: 'err. pro' = in error of; 'syn of' = species name in the left column is a synonym of the currently valid species name listed in the right column; 'transf to' = indicates the currently valid genus-species combination of the species (according to Platnick 2005).

Species	Source	Reason for exclusion
Agelenidae		
Tegenaria derhamii (Scopoli 1763)	sni; ISM	syn of *T. domestica*
Amaurobiidae		
Amaurobius americanus Emerton?	cb	species name not listed in Platnick 2005
Amaurobius bennetti (Blackwall 1846)	sni	transf to *Callobius*
Amaurobius fidelis (Banks 1892)	sni	syn of *Coras juvenilis*
Callioplus tibialis (Emerton 1888)	sni	transf to *Cybaeopsis*
Callobius borealis (Emerton 1909)	sni	transf to *Amaurobius*
Coelotes fidelis Banks 1892	c32; sni	syn of *Coras juvenilis*
Coelotes juvenilis (Keyserling 1881)	INHS; sni	transf to *Coras*
Coelotes montanus Emerton 1890	sni	transf to *Coras,* Snider lists *Coras montanus* as well
Walmus borealis Emerton 1909	L&F; LLK; DR67	listed under *Amaurobius* in Platnick 2005
Anyphaenidae		
Anyphaena rubra Emerton 1890	cb	syn of *Hibana gracilis*
Anyphaenella saltabunda (Hentz 1847)	RR; sni	transf to *Wulfila*
Aysha gracilis (Hentz 1847)	L&F; c35; DRD; L&U	transf to *Hibana*
Oxysoma cubanum Banks 1909	L&U; BEA; INHS	transf to *Arachosia*
Wulfila alba (Hentz 1847)	INHS	miscitation for *W. albens*
Araneidae		
Aculepeira carbonaria (L. Koch 1869)	L&F	Palearctic; Wisconsin specimens may have belonged to *Aculepeira verae*; no additional specimen records in the literature
Alpaida calix (Walckenaer 1805)	INHS	transf to *Metazygia*
Araneus angulatus Clerck 1775	c33; sni	Palearctic; Michigan specimens belong probably to various species (Levi 1971)
Araneus cornutus (Clerck 1757)	INHS; c32	transf to *Larinioides*
Araneus cucurbitinus Clerck 1757	c34	transf to *Araniella*; specimens most likely misidentifed and belonging to *Araniella displicata* (Snider 1971)
Araneus diademus Linnaeus 1758	sni	syn of *A. diadematus* Clerck 1757
Araneus dumetorum (Fourcroy 1785)	sni	syn of *Larinioides patagiatus*
Araneus foliatus (Fourcroy 1785)	sni	syn of *Larinioides cornutus*
Araneus gigas (Leach 1815)	BN; INHS	listed under *A. bicentenarius* in Platnick
Araneus patagiatus (Clerck 1757)	INHS; c32	transf to *Larinioides*
Araneus pratensis (Hentz 1847)	cb	transf to *Neoscona*
Araneus raji Scopoli 1763	sni	syn of *A. marmoreus*
Araneus sachimau Archer 1951	sni	syn of *A. iviei*

APPENDIX II—Continued.

Species	Source	Reason for exclusion
Araneus sericatus Clerck 1757	cb	syn of *Larinioides sclopetarius*
Araneus solitarius (Emerton 1884)	L&F; DR67	syn of *A. saevus*
Araneus triguttatus (Fabricius 1775)	L&F	Palearctic; Wisconsin specimens likely mislabeled; no additional specimen records in the literature
Araniella cucurbitina (Clerck 1757)	c34; sni	Palearctic; Michigan specimens belong probably to *Araniella displicata*
Conepeira glyphica Archer 1951	L&F	syn of *A. guttulatus*
Conepeira mayo (McCook 1893)	L&F	syn of *A. triguttatus*, Palearctic; Wisconsin specimens of *A. triguttatus* likely mislabeled; no additional specimen records in the literature
Epeira cornuta (Clerck 1757)	L&F; DR67	transf to *Larinioides*
Epeira patagiata (Clerck 1757)	L&F; DR67	transf to *Larinioides*
Epeira sericata (Clerck 1757)	DR67	syn of *Larinioides sclopetarius*
Eustala anatera (Walckenaer 1842)	DR67	err. pro *E. anastera*
Glyptocranium bisaccatum (Emerton 1884)	c35	transf to *Mastophora*
Hypsosinga variabilis (Emerton 1884)	BJK; sni	syn of *H. pygmaea*
Hypsosinga truncata (Banks 1901)	sni	syn of *H. rubens*
Larinioides sericata (Clerck 1757)	BEA	syn of *L. sclopetarius*
Neoscona benjamina Walckenaer 1842	c33	nomen dubium
Neoscona hentzi (Keyserling 1864)	INHS; L&F	syn of *N. crucifera*
Neoscona minima F. O. P.-Cambridge 1904	sni; MBC	syn of *N. arabesca*
Neoscona sacra (Walckenaer 1841)	L&F	nomen dubium, possibly specimens belong to *N. crucifera*
Neosconella pegnia (Walckenaer 1842)	INHS	transf to *Araneus*
Neosconella thaddeus (Hentz 1847)	INHS	transf to *Araneus*
Nuctenea cornuta (Clerck 1757)	INHS	transf to *Larinioides*
Nuctenea dumetora Villers [sic] 1789	sni	syn of *Larinioides patagiatus*, err. pro Fourcroy 1785
Nuctenea patagiata (Clerck 1757)	INHS	transf to *Larinioides*
Nuctenea sericata (Clerck 1757)	INHS	syn of *Larinioides sclopetarius*
Nuctenea undata Olivier 1789	sni	syn of *Larinioides sclopetarius*
Singa campestris Emerton 1915	LLK	syn of *S. keyserlingi*
Singa maculata Emerton 1884	c32	syn of *Hypsosinga rubens*
Singa pratensis Emerton 1884	L&F	transf to *Araneus*
Singa variabilis Emerton 1884	L&F; LLK; c32	syn of *Hypsosinga pygmaea*, but see Crawford 1988 for a dissenting opinion
Wixia anaglyphe (Walckenaer 1842)	KBJ; BEA; INHS	species identity unclear; listed as a 'never used' by Platnick
Zilla montana C. L. Koch 1834	c34	transf to *Zygiella*
Atypidae		
Atypus milberti Walckenaer 1837	sni	syn of *Sphodros rufipes*
Atypus niger Hentz 1852	L&F; LLK	transf to *Sphodros*
Clubionidae		
Clubiona agrestis Emerton 1924	c39	syn of *C. bryantae*
Clubiona emertoni Petrunkevitch 1911	c33	syn of *C. moesta*
Clubiona excepta L. Koch 1866	sni	transf to *Elaver*
Clubiona obtusa Emerton 1915	c39	syn of *C. trivialis*
Clubiona pallens Hentz 1847	L&F; c33; DR67	syn of *Elavor excepta*

APPENDIX II—Continued.

Species	Source	Reason for exclusion
Clubiona tibialis Emerton 1890	L&F; cb; sni	syn of *C. maritima*
Clubionoides excepta (L. Koch 1866)	INHS; sni	transf to *Elaver*
Corinnidae		
Phrurolithus alarius (Hentz 1847)	c32	transf to *Phrurotimpus*
Phrurolithus borealis Emerton 1911	c39	transf to *Phrurotimpus*
Phrurolithus formidabilis (Chamberlin & Gertsch 1930)	c39	transf back to *Phruronellus*
Phrurolithus pugnatus Emerton 1890	c33	transf to *Scotinella*
Scotinella alaria (Hentz 1847)	sni	transf to *Phrurotimpus*
Scotinella borealis (Emerton 1911)	sni	transf to *Phrurotimpus*
Scotinella delicatula (Gertsch 1935)	BEA; INHS	syn of *Phrurolithus similis*
Scotinella emertoni (Gertsch 1935)	INHS	transf to *Phrurolithus*
Scotinella formica (Banks 1895)	INHS	transf to *Phruronellus*
Scotinella formidabilis (Chamberlin & Gertsch 1930)	sni	transf back to *Phruronellus*
Scotinella goodnighti (Muma 1945)	INHS	transf to *Phrurolithus*
Scotinella similis (Banks 1895)	INHS; sni	transf to *Phrurolithus*
Trachelas deceptus (Banks 1895)	INHS; DRD	transf to *Meriola*
Ctenidae		
Ctenus bilobatus F.O.P.-Cambridge 1900	Brad	native to Mexico; occasionally imported
Cupiennius coccineus F.O.P.-Cambridge 1901	Brad	native to Costa Rica, Panama; occasionally imported
Cybaeidae		
Cybaeus silicis Barrows 1919	BN; INHS	syn of *C. giganteus*
Dictynidae		
Cicurina lowriei Levi 1951	L&F; DR67; sni	syn of *C. placida*
Conopistha trigonum (Hentz 1850)	L&F	transf to *Argyrodes*
Dictyna alias Chamberlin 1948	L&F	syn of *D. sancta*
Dictyna altamira Gertsch & Davis 1942	sni	transf to *Emblyna*
Dictyna annulipes (Blackwall 1846)	INHS; L&F; DR67; sni	transf to *Emblyna*
Dictyna bicornis Emerton 1915	INHS; L&F; sni	transf to *Phantyna*
Dictyna cruciata (Emerton 1888)	INHS; L&F; sni	transf to *Emblyna*
Dictyna frondea Emerton 1888	c35	syn of *D. foliacea*
Dictyna hentzi Kaston 1945	L&F; LLK; sni	transf to *Emblyna*
Dictyna manitoba (Ivie 1947)	INHS; L&F	transf to *Emblyna*
Dictyna maxima Banks 1892	DR67; sni	transf to *Emblyna*
Dictyna roscida (Hentz 1850)	sni	transf to *Emblyna*
Dictyna sublata (Hentz 1850)	INHS; L&F; c32; DR67; sni; BJK	transf to *Emblyna*
Scotolathys pallidus (Marx 1891)	c34; L&F; LLK	transf to *Lathys*
Gnaphosidae		
Drassodes robinsoni Chamberlin 1919	INHS	syn of *D. saccatus*
Drassodes robustus (Emerton 1890)	cb	syn of *Haplodrassus signifer*
Drassyllus femoralis (Banks 1904)	LLK	syn of *Urozelotes rusticus*
Drassyllus virginianus Chamberlin 1922	L&F; bbs	syn of *D.novus*
Drasyllus rusticus L. Koch 1872	INHS	transf to *Urozelotes*
Gnaphosa gigantea Keyserling 1887	c32	syn of *G. muscorum*

APPENDIX II—Continued.

Species	Source	Reason for exclusion
Haplodrassus magister Chamberlin 1933	INHS	syn of *Urozelotes rusticus*
Haplodrassus robustus (Emerton 1890)	sni	syn of *Haplodrassus signifer; H. signifer* also listed by Snider
Haplodrassus rubicolens Chamberlin, no year	INHS	not found in Platnick
Herpyllus vasifer (Walckenaer 1805)	L&F; c32; DR67	syn of *H.ecclesiasticus*
Litopyllus rupicolens Chamberlin 1922	INHS	syn of *L. temporarius*
Micaria aurata (Hentz 1847)	KBJ; BEA; INHS	nomen dubium according to Platnick
Micaria montana Emerton 1890	c35; pd; L&F; LLK	syn of *M. pulicaria*
Nodocion melanie Levi 1951	L&F; LLK	syn of *N. floridanus*
Poecilochroa capulata (Walckenaer 1837)	L&F; RR	transf to *Sergiolus*
Poecilochroa decorata (Kaston 1945)	sni	transf to *Sergiolus*
Poecilochroa famula (Chamberlin 1922)	L&F	syn of *Sergiolus minutus*
Poecilochroa montana Emerton 1890	L&F; sni	transf to *Sergiolus*
Poecilochroa variegata (Hentz 1847)	sni	syn of *Sergiolus capulatus*
Sostogeus zygethus (Chamberlin & Gertsch 1940)	INHS	syn of *Sosticus loricatus* (L. Koch 1866)
Trachyzelotes lyonneti (Audouin 1826)	BEA	Mediterranean; unlikely to be established; see Platnick, Murphy 1984 and Prentice et al. 1998
Zelotes ater (Hentz 1832)	c32	nomen dubium
Zelotes depressus (Emerton 1890)	c33	transf to *Drassyllus*
Zelotes subterraneus (C. L. Koch 1833)	BEA; KBJ; INHS; Brad; L&F; c34; DR67; sni	Palearctic; specimens most likely misidentified and belonging to *Zelotes fratris*
Hahniidae		
Hahnia agilis Keyserling 1887	c32	transf to *Neonatistea*
Neoantistea radula (Emerton 1890)	RR; sni; L&F	syn of *N. magna. N. riparia radula* is listed as a syn of *N. magna*, but *N. riparia* (Keyserling 1887) is listed as a valid species in Platnick. Voucher specimens will have to be examined to clearly determine which species L&F meant.
Linyphiidae		
Agyneta cauta (O. P.-Cambridge 1902)	sni	Palearctic, unlikely to be established in North America
Bathypantoides brevis (Emerton 1911)	L&F	transf to *Bathyphantes*
Bathyphantes concolor (Wider 1834)	INHS; L&F; sni	transf to *Diplostyla*
Bathyphantes nigrinus (Westring 1851)	c34; sni	Palearctic, unlikely to be established in North America
Bathyphantes pullatus (O.P.-Cambridge 1863)	LLK; sni	transf to *Kaestneria*
Bathyphantes tristis Banks 1892	L&F	syn of *Eperigone trilobata*
Catabrithorax oxypaederotipus (Crosby 1905)	sni	transf to *Collinsia*
Catabrithorax plumosus (Emerton 1882)	LLK; sni; L&U	transf to *Collinsia*
Centromerus longibullis [sic] (Emerton 1882)	sni	misspelling for *C. longibulbus*
Centromerus *serratus* Emerton 1909	sni	Palearctic, unlikely to be established in North America

APPENDIX II—Continued.

Species	Source	Reason for exclusion
Ceraticelus formosus (Banks 1892)	OHIO list	transf to *Idionella*
Ceratinella placida Banks 1892	c35	syn of *C. brunnea*
Ceratinops laticeps (Emerton 1894)	sni	transf to *Ceraticelus*
Ceratinopsis anglicana (Hentz 1850)	INHS	transf to *Tutaibo*
Ceratinopsis purpurescens (Keyserling 1886)	BEA; INHS; L&F	transf to *Styloctetor*
Ceratinopsis tarsalis Emerton 1924	BN; INHS	syn of *C. atolma* Chamberlin 1925; BEA lists *C. tarsalis* as a syn of *C. nigripalpis*
Chocorua cuneata (Emerton 1909)	LLK	syn of *Diplocephalus subrostatus*
Cochlembolus pallidus (Emerton 1882)	DR67	transf to *Scotinotylus*
Cornicularia acuminata Blackwall 1833	sni	transf to *Walckenaeria*; Palearctic, European specimens inadvertently listed for Michigan
Cornicularia brevicornis Emerton 1882	LLK; sni	transf to *Walckenaeria*
Cornicularia clavicornis Emerton 1882	L&F; DR67	transf to *Walckenaeria*
Cornicularia communis Emerton 1882	L&F; LLK; sni	transf to *Walckenaeria*
Cornicularia directa (O.P.-Cambridge 1874)	c35	transf to *Walckenaeria*
Cornicularia indirecta (O.P.-Cambridge 1874)	L&F; DR67	transf to *Walckenaeria*
Cornicularia minuta Emerton 1882	L&F; LLK; DR67	transf to *Walckenaeria*
Cornicularia pallida Emerton 1882	L&F; LLK; c35; DR67	transf to *Walckenaeria*
Cornicularia pinocchio Kaston 1945	sni	transf to *Walckenaeria*
Cornicularia tibialis Emerton 1882	sni	transf to *Walckenaeria*
Diplocephalus cuneata (Emerton 1909)	sni	syn of *D. subrostrata*
Frontinella pyramitela (Walckenaer 1841)	INHS; L&F; L&U; BJK	syn of *F. communis,* synonymy disputed, possibly nomen dubium
Glyphesis scopulifera (Emerton 1882)	BEA	transf to *Tapinocyba*
Gonatium rubens (Blackwall 1833)	BN; BEA; INHS; c34; sni; L&F; LLK	Palearctic; specimens most likely misidentified and probably belonging to *G. crassipalpum*
Grammonota spinimana Emerton 1923	LLK; DR67	syn of *G. gentilis*
Halorates oxypaederoptipus (Crosby 1905)	BEA	transf to *Collinsia*
Halorates plumosus (Emerton 1882)	BEA	transf to *Collinsia*
Hormathion limnatum Crosby & Bishop 1933	L&F	transf to *Thyreosthenius* Simon 1884 syn of *T. parasiticus* (Westring 1851)
Hybocoptus cymbadentatus Crosby & Bishop 1933	L&F; LLK	transf to *Hybauchenidium*
Islandia flaveola (Banks 1892)	INHS	err. pro *Islandiana*
Islandia longisetosa (Emerton 1882)	INHS	err. pro *Islandiana*
Lepthyphantes appalachia Chamberlin & Ivie 1944	L&F; DR67	syn of *Tenuiphantes sabulosus*
Lepthyphantes bihamata (Emerton 1882)	sni	transf to *Poeciloneta*
Lepthyphantes calcarata Emerton 1909	sni	transf to *Incestophantes*
Lepthyphantes furcata (Emerton 1913)	L&F	transf to *Poeciloneta*
Lepthyphantes nebulosa (Sundevall 1830)	KBJ; BEA; INHS; cb; DR67; RR	transf to *Megalepthyphantes*
Lepthyphantes sabulosa (Keyserling 1886)	BN; BEA; INHS; L&F; sni	transf to *Tenuiphantes*

APPENDIX II—Continued.

Species	Source	Reason for exclusion
Lepthyphantes subalpina (Emerton 1882)	DR67; L&F	syn of *L. turbatrix*
Lepthyphantes triramus Chamberlin & Ivie 1947	sni	syn of *Incestophantes duplicatus*
Lepthyphantes zebra (Emerton 1882)	BEA; L&F; sni	transf to *Tenuiphantes*
Linyphia clathrata Sundevall 1830	c33; RR	transf to *Neriene*
Linyphia communis Hentz 1850	c32	transf to *Frontinella*
Linyphia insignis Blackwall 1841	c33	transf to *Helophora*
Linyphia lineata (Linnaeus 1758)	c33	transf to *Stemonyphantes,* Palearctic; most likely not part of the Midwest fauna
Linyphia maculata Emerton 1909	L&F; sni	syn of *Neriene variabilis*
Linyphia marginata C. L. Koch 1834	L&F; c32; DR67	syn of *Neriene radiata*
Linyphia phrygiana C. L. Koch 1836	c32	transf to *Pityohyphantes*; specimens identified as *L. phrygiana* may belong to *Pityohyphantes costatus*
Linyphia pusilla Sundevall 1830	c32	transf to *Microlinyphia*
Linyphia radiata (Walckenaer 1842)	KBJ; BEA	transf to *Neriene*
Linyphia variabilis Banks 1892	c33	transf to *Neriene*
Linyphia waldea Chamberlin & Ivie 1943	INHS; L&F; DR67	syn of *Neriene clathrata*
Maso alticeps (Fox 1891)	sni	transf to *Ceraticelus*
Maso gallicus (Simon 1894)	LLK	Palearctic; most likely not part of the Midwest fauna
Maso sundevalli (Westring 1851)	LLK	syn of *M. gallicus,* Palearctic; most likely not part of the Midwest fauna
Microneta complicata Banks 1892	L&F	misidentifed
Microneta cornupalpis (O.P.-Cambridge 1875)	c35	transf to *Centromerus*
Microneta olivacea Emerton 1882	c35	transf to *Agyneta*
Microneta persoluta (O.P.-Cambridge 1875)	c35	transf to *Centromerus*
Minyriolus arenarius (Emerton 1911)	L&F; sni	transf to *Satilatlas*
Minyriolus castaneus (Emerton 1882)	L&F; DR67	transf to *Walckenaeria*
Montilaira probata (O.P.-Cambridge 1874)	BEA	transf to *Collinsia*
Neriene waldea (Chamberlin & Ivie 1943)	KBJ	syn of *N. clathrata*
Oedothorax montanus (Emerton 1882)	c35	transf to *Sisicottus*
Pityohyphantes phrygianus (C. L. Koch 1836)	c32; sni	Palearctic; specimens identified as *phrygianus* treated here as belonging to *Pityohyphantes costatus.*
Pocadicnemis hartlandiana (Emerton 1913)	DR67	transf to *Tusukuru*
Pocadicnemus pumila (Blackwall 1841)	LLK; DR67; sni	specimens belong most likely to *P. americana*
Prolinyphia marginata (C. L. Koch 1834)	INHS; BJK	syn of *Neriene radiata*
Pusillia mandibulata (Emerton 1882)	L&F; LLK; DR67	transf to *Microlinyphia*
Sciastes terrestris (Emerton 1882)	L&F; LLK; DR67	transf to *Porrhomma*
Scironis montigenus Bishop & Crosby 1938	DR67	transf to *Sisicottus*
Scotoussa bidentata (Emerton 1882)	INHS	transf to *Diplocentria*
Stemonyphantes lineatus (Linnaeus 1758)	c33; sni; L&F	Palearctic; most likely not part of the Midwest fauna
Tumagyna [sic] *debilis* (Banks 1892)	c35	misspelled for *Tunagyna*

APPENDIX II—Continued.

Species	Source	Reason for exclusion
Walckenaer [sic] *vigilax* (Blackwall 1853)	L&F; LLK; DR67; L&U; RR	syn of *W. spiralis*
Walckenaeria acuminata Blackwall 1833	sni	Palearctic, European specimens inadvertently listed for Michigan
Lycosidae		
Allocosa modesta (Keyserling 1877)	Brad	nomen dubium
Alopecosa beanii Emerton 1894	c33	syn of *A. aculeata*
Arctosa cinerea (Fabricius 1777)	c32; sni	Palearctic; most likely a misidentification for *Arctosa littoralis*
Arctosa quinaria Emerton 1894	sni	syn of a *A. raptor*
Arctosa [sic] *funerea* (Hentz 1844)	sni	most likely err pro *Allocosa funerea*
Hogna punctulata (Hentz 1844)	DRE	transf to *Rabidosa*
Hogna rabida (Walckenaer 1837)	DRE	transf to *Rabidosa*
Lycosa aspersa (Hentz 1844)	INHS; L&F; c34; sni	transf to *Hogna*
Lycosa avara (Keyserling 1877)	c35; sni; L&F	transf to *Varacosa*
Lycosa avida Walckenaer 1837	L&F; c32; DR67; sni; RR	transf to *Schizocosa*
Lycosa baltimoriana (Keyserling 1877)	INHS; L&F; DR67; sni	transf to *Hogna*
Lycosa carolinensis (Walckenaer 1805)	INHS; L&F; c32; sni	transf to *Hogna*
Lycosa fatifera Hentz 1842	c33	transf to *Geolycosa*
Lycosa frondicola (Emerton 1885)	INHS; L&F; c32; DR67; sni; bbs; RR	transf to *Hogna*
Lycosa georgicola (Walckenaer 1837)	BEA; INHS	transf to *Allocosa*
Lycosa gulosa (Walckenaer 1837)	INHS; L&F; c32; sni	transf to *Gladicosa*
Lycosa helluo (Walckenaer 1837)	INHS; L&F; c33; DR67; sni	transf to *Hogna*
Lycosa hentzi Banks 1904	INHS	transf to *Rabidosa*
Lycosa insularis Emerton 1855	sni	species identity uncertain; the only lycosid with the species name *insularis* described by Emerton was never placed into genus *Lycosa* (see genus *Pirata*). *Lycosa insularis* Lucas from Cuba is unlikely to be conspecific with Michigan specimens.
Lycosa modesta (Keyserling 1877)	sni	transf to *Allocosa,* nomen dubium
Lycosa nidifex (Marx 1881)	c34	syn of *Geolycosa turricola*
Lycosa pikei Marx 1881	c33	transf to *Geolycosa*
Lycosa pratensis Emerton 1885	L&F; c33; DR67; RR	syn of *Trochosa terricola*
Lycosa pulchra (Keyserling 1877)	INHS	transf to *Gladicosa*
Lycosa punctulata (Hentz 1844)	INHS; c35; sni	transf to *Rabidosa*
Lycosa rabida (Walckenaer 1837)	INHS	transf to *Rabidosa*
Lycosa riparia Hentz 1844	c35; sni	syn of *Allocosa georgicola*
Pardosa emertoni Chamberlin 1908	c32	syn of *P. distincta*
Pardosa longispinata Tullberg 1901	sni	syn of *P. littoralis*
Pardosa modica brunnea Emerton 1885	c35	syn of *P modica*
Pardosa tachypoda (Thorell 1878)	sni	syn of *P. xerampelina*

APPENDIX II—Continued.

Species	Source	Reason for exclusion
Pirata arenicola Emerton 1909	L&F; DR67	syn of *P. aspirans*
Pirata febriculosus (Becker 1881)	c32	syn of *P. piraticus*
Pirata maculatus Emerton 1909	L&F; c35; MBC; ISM	syn of *P.sedentarius*
Pirata marxi Stone 1890	INHS; DR67; sni	transf to *Trebacosa*
Pirata sylvestris Emerton 1909	c35; sni	syn of *P. insularis*
Schizocosa crassipalpis (Emerton 1909)	L&F; RR	syn of *S. crassipalpata*
Tarentula aculeata (Clerck 1757)	L&F; DR67; sni	transf to *Alopecosa*
Trabea aurantiaca (Emerton 1885)	L&F	transf to *Trabeops*
Trochosa avara (Keyserling 1877)	INHS	transf to Varacosa
Trochosa pratensis (Emerton 1885)	sni	syn of *T. terricola*
Mimetidae		
Ero furcata (Villers 1789)	BN; BEA; INHS; Brad; L&F; c35; sni	Palearctic; specimens most likely misidentifed and belonging to *Ero leonina* (Kaston 1981)
Mimetus interfector Hentz 1850	c35; sni	syn of *M. syllepsicus*
Mysmenidae		
Mysema (misspelling) *guttata* Banks 1895	INHS	transf to *Microdipoena*
Mysmena guttata (Banks 1895)	BN; BEA; INHS	transf to *Microdipoena*
Nesticidae		
Nesticus pallidus (Emerton 1875)	NSE; L&F	transf to *Eidmannella*
Oecobiidae		
Oecobius annulipes Lucas 1846	OHIO list	listed as O. *annulipes* Lucas 1846. However, *O. annulipes* is reported from Algeria. Most likely the specimens from Ohio belong to *O. navus*.
Oecobius texanus Bryant 1936	MBC	syn of *O. cellariorum*
Philodromidae		
Philodromus abotti Walckenaer 1837	L&F; L&U	nomen dubium
Philodromus aureolus (Clerck 1757)	L&U; L&F; c40	Palearctic; specimens most likely misidentified and belonging to *Philodromus cespitum*
Philodromus canadensis Emerton 1917	c34	syn of *P.cespitum*
Philodromus crespiticolus [sic] (Walckenaer 1805)	DR67	err pro *P. cespiticolens*. syn of *P. cespitum*
Philodromus emertoni Bryant 1933	c35; sni	syn of *P. mineri*
Philodromus lentiginosus Keyserling 1881	c35; sni	syn of *P. histrio*
Philodromus lineatus Emerton 1892	cb	syn of *P. imbecillus*
Philodromus pictus Emerton 1892	c34	syn of *P. rufus*
Philodromus washita Banks, Newport & Bird 1932	L&U	syn of *P. keyserlingi*
Rhysodromus alascensis (Keyserling 1884)	sni	transf to *Philodromus*
Thanatus formicus [sic] (Clerck 1757)	DR67	err pro *T. formicinus*
Tibellus americanus Gertsch?	KBJ; INHS	species name not found in Platnick's catalog vers. 5
Pholcidae		
Spermophora meridionalis Hentz 1841	L&F	syn of *S. senoculata*

APPENDIX II—Continued.

Species	Source	Reason for exclusion
Pisauridae		
Dapanus mirus (Walckenaer 1837)	L&F	transf to *Pisaurina*
Dolomedes fulviatronotatus Bishop 1924	sni	syn of *D. striatus*
Dolomedes scopularis [sic] C. L. Koch 1847	DR67; sni; L&F	syn of *D. triton,* err. pro *scapularis*
Dolomedes triton sexpunctatus Hentz 1845	c33; sni	syn of *D. triton*
Dolomedes urinator Hentz 1845	cb	syn of *D. vittatus*
Admestina tibalis [sic] (C. L. Koch 1846)	sni	err pro *A. tibialis*
Salticidae		
Agassa *cerulea* (Walckenaer 1837)	INHS	nomen dubium
Ballus youngi (Peckham & Peckham 1888)	L&F	transf to *Attidops*
Dendryphantes capitatus (Hentz 1845)	c32	syn of *Pelegrina proterva,* dark specimens may be misidentifed and belong to *P. galathea* (Cutler, pers. com., see Maddison 1996)
Eris marginata (Walckenaer 1837)	INHS; sni; L&U	syn of *Hentzia palmarum*
Evarcha falcata (Clerck 1757)	sni	Palearctic; most likely a specimen of *Evarcha hoyi*
Fuentes lineata (C. L. Koch 1846)	c44	transf to *Marpissa*
Gertschia "dakotensis" "Cutler", unpublished	RR	manuscript name by Cutler (1970, unpublished thesis), synonym of *Synageles occidentalis*
Gertschia noxiosa (Hentz 1850)	L&F; sni	transf to *Synageles*
Habrocestum parvulum (Banks 1895)	KBJ; BEA; INHS; Brad; LLK	transf. to *Chinattus*
Habrocestum pulex (Hentz 1846)	KBJ; BEA; INHS; ISM; NSE; Brad; L&F; RR; c33; c44; DR67; sni; bbs	transf. to *Naphrys*
Habronattus arizonensis Banks 1904	INHS	syn of *H. conjunctus*
Habronattus coronatus (Hentz 1846)	INHS; MBC	syn of *H. coecatus*
Habronattus peregrinus (Peckham & Peckham 1883)	c44	syn of *H. viridipes*
Habronattus rutherfordi (Gertsch & Mulaik 1936)	INHS; L&U	syn of *H. texanus*
Hentzia ambigua (Walckenaer 1837)	L&F	syn of *H. palmarum*
Hyctia bina (Hentz 1846)	L&F; c44; sni	transf to *Marpissa*; considered a syn of *Marpissa formosa* by some authors
Hyctia pikei Peckham 1888	L&F; sni	transf to *Marpissa*
Icius elegans (Hentz 1846)	L&F; LLK; DR67; sni	transf to *Tutelina*
Icius fontanus Levi 1951	L&F	transf to *Paradamoetas*
Icius formicarius (Emerton 1891)	c33; sni	transf to *Tutelina*
Icius harti (Peckham in Emerton 1891)	NSE; L&F; sni	transf to *Tutelina*
Icius similis Banks 1895	L&F; DR67; sni	transf to *Tutelina*
Maevia vittata (Hentz 1846)	cb; c44; bbs	syn of *M. inclemens*

APPENDIX II—Continued.

Species	Source	Reason for exclusion
Marpissa bina (Hentz 1846)	BEA	listed as a syn of *M. formosa* in BEA; not a syn of *formosa* according to Platnick 2005. Unclear whether the species occurs in any of the five Midwest states treated here.
Marpissa undata (DeGeer 1778)	L&F; cb; sni; DR67	transf to *Platycryptus*
Metacyrba undata (DeGeer 1778)	DR67	transf to *Platycryptus*
Metaphidippus canadensis (Banks 1897)	NSE; L&F; c44; sni	transf to *Ghelna*
Metaphidippus capitatus (Hentz 1845)	c34	syn of *Pelegrina proterva*, dark specimens may be misidentifed and belong to *P. galathea* (Cutler, pers. com., see Maddison 1996
Metaphidippus flaviceps (Kaston 1973)	MPM	transf to *Pelegrina*
Metaphidippus flavipedes (Peckham 1881)	L&F; c34; c44; DR67; sni	syn of *Pelegrina flavipes*
Metaphidippus galathea (Walckenaer 1837)	BJK; w84; sni; L&U	transf to *Pelegrina*
Metaphidippus insignis (Banks 1892)	L&F; w84; sni	transf to *Pelegrina*
Metaphidippus montanus Emerton 1891	cb; c44	transf to *Pelegrina*
Metaphidippus protervus (Walckenaer 1837)	KBJ; DR67; sni; L&U; BJK; RR	transf to *Pelegrina*
Myrmarachne hentzi Banks 1913	MBC	transf to *Sarinda*
Onondaga lineata (C. L. Koch 1848)	L&F; sni; RR	transf to *Marpissa*
Paraphidippus marginatus (Walckenaer 1837)	L&F; c33; c44; DR67	syn of *Hentzia palmarum*
Pellenes agilis (Banks 1893)	c34; sni	transf to *Habronattus*
Pellenes borealis (Banks 1895)	c33; sni	transf to *Habronattus*
Pellenes calcarata Banks 1904	sni	transf to *Habronattus*
Pellenes cognatus (Peckham & Peckham 1901)	sni	transf to *Habronattus*
Pellenes coronatus (Hentz 1846)	sni	syn of *Habronattus coecatus*
Pellenes decorus (Blackwall 1846)	c34; sni	transf to *Habronattus*
Pellenes leucophaea (C. L. Koch 1846)	sni	syn of *Pelegrina galathea*
Pellenes peregrinus (Peckham 1883)	c34	syn of *Habronattus viridipes*
Pellenes pulex (Hentz 1846)	sni	transf to *Naphrys*
Pellenes texanus (Chamberlin 1924)	sni	transf to *Habronattus*
Pellenes viridipes (Hentz 1846)	sni	transf to *Habronattus*
Phidippus altanus Gertsch 1934	L&F; c44	syn of *P. borealis*
Phidippus brunneus Emerton 1891	c44	syn of *P. princeps*
Phidippus electus C. L. Koch 1846	c35	syn of *P. mystaceus*
Phidippus fraudulentus (Walckenaer 1837)	KBJ; BEA; INHS	nomen dubium; listed in BEA as a syn of *P. insignarius*
Phidippus mccooki (Peckham 1883)	KBJ; BEA; INHSD; ISM	syn of *P. cardinalis* (see Edwards 2004)
Phidippus rimator (Walckenaer 1837)	L&F; RR	nomen dubium; LF give *P. clarus* as a synonym. Wisconsin specimens may belong to *P. clarus*
Phlegra fasciata (Hahn 1826)	BN; BEA; Brad; L&F; LLK; cb; c44; sni	Palearctic; North American specimens were misidentified and belong to the re-validated species *Phlegra hentzi* (see Lugonov & Koponen 2002)

APPENDIX II—Continued.

Species	Source	Reason for exclusion
Salticus hentzi (Banks 1913)	MBA; BEA; INHS	transf to *Sarinda*
Sarinda papenhoei (Peckham & Peckham 1895)	BN; BEA; INHS	returned to *Sassacus*
Sassacus aemulus Gertsch 1934	L&F	transf to *Sibianor*
Sitticus cursor (Barrows 1919)	KBJ; INHS	syn of *S. concolor*
Sitticus floridanus Gertsch & Mulaik 1936	RR	syn of *S.concolor*
Sitticus palustris (Peckham & Peckham 1883)	KBJ; BEA; INHS; ISM; c33; c44; DR67; sni; BJK	listed in Platnick as *S. floricola palustris*
Synemosyna lunata (Walckenaer 1837)	L&F	Nomen dubium; LF list *S. formica* as a syn. Wisconsin specimens may belong to *S. formica*
Thiodina irrorata (Walckenaer 1837)	KBJ; BEA; INHS	Nomen dubium, listed in BEA as a syn of *T. puerpera*
Wala palmarum (Hentz 1832)	cB	transf to *Hentzia*
Zygoballus bettini Peckham & Peckham 1888	INHS; L&F; LLK; c44; sni	syn of *Z. rufipes*
Zygoballus sextpunctatus (Hentz 1845)	INHS	listed incorrectly as syn of *Z. melloleitaoi*; see Platnick for explanation
Heteropodidae		
Heteropoda venatoria (Linnaeus 1767)	Brad; MPM	Pantropical, occasionally imported
Tetragnathidae		
Eucta lacerta (Walckenaer 1842)	c32	transf to *Tetragnatha lacerta,* nomen dubium
Meta menardi (Latreille 1804)	KBJ; BEA; INHS; LEV; ISM	Palearctic, specimens most likely misidentified and belonging to *Meta ovalis* (see Marusik & Koponen 1992 and Dondale 1995)
Mimognatha foxi (McCook 1894)	L&F; L&U	transf to *Glenognatha*
Pachygnatha kuratai Levi 1951	L&F; LLK; DR67; sni; RR	syn of *P. dorothea*
Tetragnatha banksi McCook 1893	L&F	syn of *T. guatemalensis*
Tetragnatha harrodi Levi 1951	L&F; LLK; c59; DR67; ISM	syn of *T. dearmata*
Tetragnatha rusticana Chickering 1959	c59; sni	syn of *T. extensa*
Tetragnatha seneca Seeley 1928	RR; sni	syn of *T. guatemalensis*
Theridiidae		
Allotheridion alabamense (Gertsch & Archer 1942)	L&F	transf to *Keijia*
Allotheridion albidum (Banks 1895)	L&F	transf back to *Theridion*
Allotheridion differens (Emerton 1882)	L&F	transf back to *Theridion*
Allotheridion fieldi Levi 1951	L&F	syn of *Theridion hemerobium*
Allotheridion frondeum (Hentz 1850)	L&F	transf back to *Theridion*
Allotheridion glaucescens (Becker 1879)	L&F	transf back to *Theridion*
Allotheridion lyricum (Walckenaer 1842)	L&F	transf to *Takayus*
Allotheridion murarium (Emerton 1882)	L&F	transf back to *Theridion*
Allotheridion zelotypum Emerton 1882	L&F	syn of *Theridion pictum*
Ancylorrhanis hirsutum (Emerton 1882)	L&F; LLK	transf to *Pholcomma*
Argyrodes cancellatus (Hentz 1850)	B&N; BEA; INHSD; Brad	transf to *Faiditus*

APPENDIX II—Continued.

Species	Source	Reason for exclusion
Argyrodes fictilium (Hentz 1850)	B&N; BEA; INHSD; Brad	transf to *Rhomphaea*
Argyrodes trigonum (Hentz 1850)	B&N; BEA; INHSD; FMNH, ISM; Brad: L&F; LLK, C33; DR67; sni;	transf to *Neospintharus*
Asagena americana Emerton 1882	L&F; c34	transf to *Steatoda*
Coressa stridula Crosby 1906	LLK	transf back to *Theonoe*
Crustulina guttata (Wider 1834)	c33	Palearctic; Chickering's specimens most likely belong to *C. altera*
Cryptachaea rupicola (Emerton 1882)	L&F	transf to *Achaearanea*
Ctenium banksi Kaston 1946	L&F; LLK	transf to *Robertus*
Ctenium eremophilum Chamberlin in Chamberlin & Gertsch 1928	L&F	transf to *Robertus*
Ctenium fusca (Emerton 1894)	sni	transf to *Robertus*
Ctenium laticeps (Keyserling 1884)	LLK; sni	transf to *Robertus*
Ctenium longipalpum Kaston 1946	L&F	transf to *Robertus*
Ctenium riparius (Keyserling 1886)	L&F; sni	transf to *Robertus*
Ctenium similis Kaston 1946	sni	transf to *Robertus*
Ctenium spiniferum (Emerton 1909)	LLK	transf to *Robertus*
Dipoena prona (Menge 1868)	BN; BEA; INHS	transf to *Lasaeola*
Enoplognatha rugosa (Emerton 1909)	INHS; LLK	syn of *E. intrepida*
Enoplognatha tecta Keyserling 1884	BN; BEA; INHS; LLK; sni; BJK	syn of *E. caricis*
Euryopis californica Banks 1904	L&F	Western species; specimens most likely belong to *Euryopis pepini*
Euryopis limbata (Walckenaer 1842)	INHS; L&F; sni; RR	nomen dubium; specimens belong most likely to *E. funebris*
Hentziectypus globosum (Hentz 1850)	L&F	transf to *Archaeranea*
Lactrodectus curacaviensis (Müller 1776)	LLK; LLK	Wisconsin specimens likely to belong to *L. variolus*
Lactrodectus mactans (Fabricius 1775)	L&F	Wisconsin specimens likely to belong to *L. variolus*, see note in LLK: 45
Latrodectus hesperus Chamberlin & Ivie 1935	Brad	western North American species, occasionally imported with fruits
Lithyphantes albomaculatus (DeGeer 1778)	L&F	transf to *Steatoda*
Lithyphantes corollatus (Linnaeus 1758)	c32	transf to *Steatoda;* nomen dubium
Paidisca unimaculata Emerton 1882	sni; L&U	transf to *Thymoites*
Parasteatoda tepidariorum C. L. Koch 1841	L&F	transf to *Achaearanea*
Sphyrotinus unimaculatus (Emerton 1882)	LLK	transf to *Thymoites*
Teutana triangulosa (Walckenaer 1802)	L&F; sni	transf to *Steatoda*
Theridion alabamense (Gertsch & Archer 1942)	LLK	transf to *Keijia*
Theridion antoni Keyserling 1884	BN; BEA; INHS	transf to *Keijia*
Theridion aurantium (Emerton 1915)	LLK; sni	transf to *Rugathodes*
Theridion berkeleyi Emerton 1924	BN; BEA; INHS; LLK; sni	syn of *T. hemerobium*

APPENDIX II—Continued.

Species	Source	Reason for exclusion
Theridion crispulum (Simon 1895)	BEA	transf to *Wamba*
Theridion globosum Hentz 1850	c35	transf to *Achaearanea*
Theridion lyricum Walckenaer 1842	sni; LLK	transf to *Takayus*
Theridion marmoratum Hentz 1850	L&F	transf to *Enoplognatha*
Theridion ornatum Hahn 1831	DR67; sni	syn of *T. pictum*
Theridion punctisparsum [sic] Emerton 1883	c32	transf to *Keijia,* err. pro *punctosparsum*
Theridion punctosparsum Emerton 1882	KBJ; BEA; INHS	transf to *Keijia*
Theridion puritanum (Chamberlin & Ivie 1942)	L&F	syn of *Enoplognatha caricis*
Theridion rugosum (Emerton 1909)	L&F; LLK	syn of *Enoplognatha intrepida*
Theridion sexpunctatum Emerton 1882	L&F; LLK; c34; DR67	transf to *Rugathodes*
Theridion spirale Emerton 1882	c32	syn of *T. glaucescens*
Theridion tepidariorum C. L. Koch 1841	c32	transf to *Achaearanea*
Theridion zelotypum Emerton 1882	c32	syn of *T. pictum*
Theridula sphaerula (Hentz 1850)	L&F	*T. sphaerula* is a misidentification by Levi & Field, Wisconsin specimens belong to *Theridula emertoni* (Levi, Levi & Kaspar 1958); *T. sphaerula* is a syn of *T. opulenta*
Tholocco unimaculatum (Emerton 1882)	L&F; LLK	transf to *Thymoites*
Ulesanis americana Emerton 1882	sni	transf to *Phoroncidia*
Theridiosomatidae		
Theridiosma radiosum (McCook 1881)	L&F	syn of *T. gemmosum*
Thomisidae		
Coriarachne utahensis (Gertsch 1932)	sni	transf to *Bassaniana*
Coriarachne versicolor Keyserling 1880	INHS; c40; DRC	transf to *Bassaniana*
Misumena calycina (Linnaeus 1758)	L&U	syn of *M. vatia*
Misumena rosea Keyserling 1880	sni	syn of *Misumenops asperatus*
Misumenoides aleatorius (Hentz 1847)	cb; c40	syn of *M. formosipes*
Misumenops delphinus (Walckenaer 1837)	INHS	syn of *M. celer*
Oxyptila americanus Banks 1895	LLK	*Oxyptila*: unjustified emendation of *Ozyptila*
Oxyptila monroensis Keyserling 1884	LLK	*Oxyptila*: unjustified emendation of *Ozyptila*
Ozyptila bryantae Gertsch 1939	RR	syn of *O. conspurcata*
Ozyptila nevadensis (Keyserling 1880)	LLK	transf to *Xysticus*
Xysticus banksi Gertsch [sic] 1933	cb	err. pro Bryant
Xysticus graminis Emerton 1892	cb; c40	syn of *X. bicuspis*
Xysticus lemniscatus (Walckenaer 1837)	KBJ; INHS	nomen dubium
Xysticus limbatus Keyserling 1880	c33	syn of *X. emertoni*
Xysticus lutulentus Gertsch 1934	L&F; LLK	syn of *X. luctuosus*
Xysticus obscurum Keyserling 1880	sni	syn of *X. ellipticus*
Xysticus ontariensis Emerton 1919	L&F; RR	syn of *X. pellax*; see note in text
Xysticus transversatus (Walckenaer 1837)	L&F	syn of *X. ferox*
Xysticus tumefactus (Walckenaer 1837)	INHS	syn of *X. funestus*
Uloboridae		
Uloborus americanus Walckenaer 1842	cb; L&F	nomen dubium; specimens cited for Michigan and Wisconsin belong most likely to *U. glomosus*
Uloborus octonarius Muma 1945	INHS; MBC	syn of *Octonoba sinensis*

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THE AMPHIBIANS OF THE MERRY LEA ENVIRONMENTAL LEARNING CENTER OF GOSHEN COLLEGE, NOBLE COUNTY, INDIANA

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ABSTRACT. We report the results of a survey of amphibians near Wolf Lake, Noble County, Indiana. From 1995 to 2001 we conducted terrestrial surveys of adult amphibians, anuran calls, and aquatic surveys of spring breeding amphibians and fall amphibians beginning to hibernate in wetland sediments of temporary, semi-permanent and permanent wetlands. We collected 20 of the 22 amphibians whose published ranges include Noble County. In our survey we established the presence of *Ambystoma jeffersonianum*, *A. laterale*, *A. maculatum*, *A. texanum*, unisexual *Ambystoma* hybrids, *Bufo americanus*, *B. fowleri*, *Acris crepitans blanchardi*, *Hyla chrysoscelis*, *H. versicolor*, *Rana catesbeiana*, and *R. palustris*. We also collected *Ambystoma tigrinum tigrinum*, *Plethodon cinereus*, *Notophthalmus viridescens viridescens*, *Pseudacris crucifer*, *P. triseriata triseriata*, *Rana clamitans melonata*, *R. pipiens*, and *R. sylvatica*. Amphibians, including *A. crepitans blanchardi*, have readily established in restored wetlands.

Keywords: Amphibians, species diversity, Merry Lea Environmental Learning Center of Goshen College, Noble County, conservation

Studies of global amphibian decline point to complex causes, including habitat loss, pesticide poisoning, introduction of new predators, changing hydroperiod, parasites, UV radiation, and warming climate (for examples, see Wake 1991; Blaustein & Kiesecker 2002; Hayes et al. 2002; Garcia et al. 2004; Mills & Semlitsch 2004; Rohr et al. 2004). The science of amphibian decline has matured such that it can clarify the effect of the interactions and synergisms of a combination of stressors on species and populations (see above studies). Conservation of amphibian species under such assault will require the preservation of habitat that minimizes or mediates the causes of decline, and the perceived urgency of conservation efforts in local areas will undoubtedly be linked to an understanding of the rate of decline. Not all areas in Indiana have been adequately surveyed for populations of amphibian species known to have historically existed or invaded, so good habitat and decline rates are not completely identified.

Prior to current agricultural development, Noble County, Indiana, consisted of extensive wetlands and uplands of glacial origins. If the original wetlands were as diverse as the remnant wetlands, Noble County in pre-settlement times supported many amphibian species. In addition to diverse wetland habitat, amphibians need well-drained but moist uplands to support adult amphibians and those amphibians that do not use wetlands for breeding. The current uplands in Noble County support mesic maple and oak-hickory forests that are suitable habitat for amphibians. Current wetland land cover is a small fraction of pre-settlement wetlands, and the wetland and upland habitats have been fragmented by development. Multiple studies suggest that this sort of fragmentation and habitat loss is a contributing factor in amphibian decline (Semlitsch 2000; Pellet et al. 2003).

Semlitsch & Bodie (2003) proposed a system of buffers and preserved upland adult habitat around breeding wetlands to protect amphibian populations. The buffers protect the wetlands from chemical contamination and adult habitat from disturbance. The proposed system of protected land would form a ring 222–399 m wide around each wetland. Since a large percentage of the land of Noble

County is used for agriculture, only a few areas have enough appropriate upland around breeding wetlands to protect the amphibian habitat as Semlitsch & Bodie (2003) suggest.

The Merry Lea Environmental Learning Center of Goshen College, located in Noble County, is a rich environment for amphibians. It contains many wetland complexes connected by forest and grassland uplands. It therefore approximates the habitat in Noble County prior to extensive agricultural development. Although much of the Learning Center environment has had significant human impact such as farming, draining, or timber harvest, current management is actively restoring historic ecosystems and other ecosystems have begun to recover on their own. Because of the Center's large contiguous area (470 ha) and management history, amphibian habitat is less fragmented than in surrounding areas. Wetland complexes at Merry Lea are connected by uplands suitable for buffering and adult habitat. The restoration and creation of permanent ponds and marshes added further critical amphibian habitat for many anurans.

We report results from studies of amphibian populations conducted for seven years at our study property. The studies were diverse and included fall and spring terrestrial surveys, fall and spring trapping of amphibians in wetlands, and anuran call surveys. Amphibian species observed were compared with those expected (Petranka 1998; Minton 2001) and documented for Noble County (Minton 2001).

METHODS

Study area.—The Merry Lea Environmental Learning Center is a 470 ha natural area that is a diverse assemblage of ecosystems including a wide variety of wetlands, upland forests, prairies, meadows and restored oak savanna. The study site is located in central Noble County, Indiana (45 km NW of Fort Wayne, Indiana, and 10 km SW of Albion, Indiana). Much of the property is bordered by three small lakes (Bear Lake, Cub Lake, and High Lake) that are the survivors of the draining of a larger lake/wetland complex for agricultural purposes around 1900.

Within the study area, wetlands with different hydroperiods and forest cover support diverse amphibian communities. Most of the permanent open wetlands are restored wetlands and are within the shorelines of the original lake. There are also several permanent swamps and shrub-carrs (swamps dominated by tall shrubs and included with swamps in Tables 2 and 3). The distinguishing feature of the Learning Center is an abundance of true temporary wetlands. Many forested temporary ponds exist in the oak-hickory woodlands that bordered the original lake, and several temporary silver maple swamps thrive in the old lakebed. Some of the forested wetlands exhibit semi-permanent hydrology in wet years. In addition, several open temporary ponds have been excavated to facilitate drainage along trails.

All permanent wetlands contain plant communities typical of the Northern Lakes Natural Region of Indiana (Homoya et al. 1985). The edges support *Typha latifolia*, *T. augustifolia*, *Scirpus cyperinus*, *Schoenoplectus validus*, *Schoenoplectus acutus*, various *Carex* and *Juncus* species, *Bidens cernua*, *Altissima plantago-aquatica*, *Leersia oryzoides* and *Phalaris arundinacea*. The shallow waters support *Potamogeton* sp., *Eleocharis* sp., *Polygonum* sp., *Utricularia vulgaris*, *Ceratophyllum demersum* and *Chara* species. Some permanent wetlands have deep waters that contain no vegetation. One permanent wetland and two temporary wetlands are dominated by buttonbush (*Cephalanthus occidentalis*). The shrub-carr contains the woody plants *Cornus stolonifera*, *C. sericea*, *Acer saccharinum*, *Salix exigua*, and *Ilex verticillata*. The small open temporary ponds support a subset of the species found in the open permanent ponds. The forested temporary ponds are generally devoid of vegetation in the wetland basin.

Survey techniques.—Amphibians were surveyed in the spring (1997–2001) and fall (1995–2001). Because the semi-permanent wetlands only exhibited a permanent hydroperiod in one wet year during our study and in all other years of the study dried in fall, results from those wetlands were combined with those of temporary wetlands. In the springs of 1998 to 2001, anurans were monitored using standard call survey techniques (Scott & Woodward 1994), with three call surveys done each season. Amphibian species were identified by their calls and abundance was estimated using a three point scale: 1 = individuals can be counted, 2 = calls of individuals can be distinguished but there are some overlapping of calls, and 3 = full chorus and calls are constant, continuous and overlapping. Salamanders and some anurans were surveyed using minnow traps set in a subset of the wetlands (Adams et al. 1997). These were not baited and were checked daily for the duration of the *Ambystoma* mating season (usually mid-February through mid-April). Each wetland was sampled with the same intensity (1 trap per 7 m of perimeter). For most years, wetlands with a range of hydroperiods in one 25 ha area were trapped. In the spring of 2001, eight new temporary wetlands (all wooded wetlands), one new temporary swamp, and one new permanent wetland were trapped in five other areas of Merry Lea. Finally, some terrestrial surveys were conducted in spring by turning over logs and woody debris from mid-February to early June. Most spring terrestrial surveys were not systematic, but in three years (1998, 2000, and 2002) college classes turned over all woody debris in two 4 ha oak-hickory woods, and in two years (2000 and 2002) in one 2 ha oak-hickory woods (Crump & Scott 1994). Identification and number of salamanders were recorded. Only *Plethodon cinereus* density data will be reported since other salamander species found are primarily fossorial species; consequently our collection could not accurately reflect their densities.

Many wetlands and terrestrial areas were sampled again in the fall using minnow trapping and terrestrial surveys. Since temporary wetlands dried by August, only permanent wetlands were trapped in the fall. More terrestrial surveys were conducted between September and November of 1998 and 1999. Woody debris in appropriate uplands was overturned and the presence of amphibian species was recorded. During the rest of the year, all amphibians encountered were noted. Voucher specimens or photographs are stored in the collections of the Learning Center.

RESULTS

Eight salamander species and 12 anuran species were encountered during the study period for a total amphibian species richness of 20 species (Table 1). Seven salamander species (*Ambystoma jeffersonianum*, *Ambystoma laterale*, *Ambystoma maculatum*, *Ambystoma texanum*, *Ambystoma tigrinum tigrinum*, *Ambystoma* unisexual hybrids, and *Notophthalmus viridescens viridescens*) and five anuran species (*Bufo americanus*, *Pseudacris crucifer*, *Pseudacris triseriata triseriata*, *Rana pipiens* and *Rana sylvatica*) were captured during spring trapping. All *Ambystoma*, *Plethodon cinereus*, *N. viridescenes viridescens*, and *R. sylvatica* were collected during terrestrial surveys of the uplands around surveyed wetlands. All anurans were heard during the call surveys and encountered during spring and summer months near the wetlands.

Caudata.—Of the nine salamander species (and *Ambystoma* hybrids) whose ranges include Merry Lea, seven were encountered during our surveys (Table 1). All expected *Ambystoma* species were collected in spring trapping of breeding ponds, including members of the *A. jeffersonianum* complex of unisexual hybrids. In addition to those *Ambystoma* expected, *A. jeffersonianum* (Jefferson's salamander) was collected. Of the diploid species, *A. texanum* (smallmouth salamander) was by far the most abundant (Table 2), being found in large numbers in wooded temporary ponds on the east side of the Learning Center property and rarely on the west side. The next most abundant species was *A. laterale*, but this field designation includes unisexual hybrids, so it is unclear how many diploid bisexual *A. laterale* were actually collected. *Ambystoma tigrinum tigrinum* (eastern tiger salamander), *A. jeffersonianum*, and *A. maculatum* (spotted salamander) were rarer.

Plethodon cinereus (red-backed salamander) was common in spring and fall terrestrial surveys of upland oak-hickory forests. A total of 224 red-backed salamanders was captured with 63.8% red-backed and 36.2% lead-backed morphs. The average density of *P. cinereus* in eight surveys conducted in three years was 2.7 ± 0.02 (mean ± standard error) salamanders/ha.

Notophthalmus viridescens viridescens (eastern newt) was less abundant than the other salamanders collected. Eight eastern newts were collected in minnow traps in spring and fall in a permanent and a semipermanant wetland dominated by buttonbush. In addition, eastern newt adults were collected in spring and fall terrestrial surveys of the uplands surrounding those wetlands.

Of the salamanders whose ranges include the study site, *Hemidactylium scutatum* (four-toed salamander) and *Necturus maculosus* (mudpuppy) were not collected. In an exten-

Table 1.—Amphibian species of Merry Lea Environmental Learning Center of Goshen College. F = found during this study, R = included in range maps of Minton (2001) or Petranka (1998), M = Minton county record, and N = new county record.

Species expected	Common name	F	R	M	N
Caudata					
Ambystomatidae					
Ambystoma jeffersonianum	Jefferson's salamander	X			X
A. laterale	Blue-spotted salamander	X	X		X
A. maculatum	Spotted salamander	X	X		X
A. texanum	Smallmouth salamander	X	X		X
A. tigrinum tigrinum	Eastern tiger salamander	X	X	X	
Unisexual *Ambystoma*		X	X		X
Plethodontidae					
Hemidactylium scutatum	Four-toed salamander	X	X		
Plethodon cinereus	Red-backed salamander	X	X	X	
Proteidae					
Necturus maculosus	Mudpuppy		X		
Salamandridae					
Notophthalmus viridescens viridescens	Eastern newt	X	X	X	
Anura					
Bufonidae					
Bufo americanus	American toad	X	X		X
B. fowleri	Fowler's toad	X	X		X
Hylidae					
Acris crepitans blanchardi	Blanchard's cricket frog	X	X		X
Hyla chrysoscelis	Cope's gray treefrog	X	X		X
H. versicolor	Eastern gray treefrog	X	X		X
Pseudacris crucifer	Spring peeper	X	X	X	
P. triseriata triseriata	Western chorus frog	X	X	X	
Ranidae					
Rana catesbeiana	Bullfrog	X	X		X
R. clamitans melonata	Green frog	X	X	X	
R. palustris	Pickerel frog	X	X		
R. pipiens	Northern leopard frog	X	X	X	
R. sylvatica	Wood frog	X	X	X	

sive survey of Merry Lea's bogs and remnant bogs, the four-toed salamander was not seen (A. Swinehart pers. commun.). Later surveys by one of the authors (MCL) also did not find any specimen. The study site does contain some typical *N. maculosus* habitat, but mudpuppies were not encountered in pond or ditch surveys. There exist accounts of mudpuppies caught by fishermen in High Lake and Bear Lake, but these accounts cannot be verified.

Throughout the study period, ambystomatid salamanders exhibited a strong preference for breeding in temporary ponds and in most years were trapped only in wetlands of this type (Table 2). In the spring of 2000 we observed a shift in *Ambystoma* breeding to temporary swamps and a permanent swamp (Table 2) which coincided with a drought that kept the temporary ponds we surveyed from filling in the fall of 1999 or spring of 2000. The permanent shrub-carr where most of the spring 2000 breeding occurred had dried to isolated deeper pools. This permanent shrub-carr had been surveyed in the previous spring seasons, but no breeding salamanders had been captured.

Anura.—All anuran species expected to be found at the Learning Center were encountered (Table 1). Call surveys showed *H. chrysoscelis* (Cope's gray treefrog), *H. versicolor* (eastern gray treefrog), *P. crucifer* (spring peeper) and *P. triseriata triseriata* (western chorus frog) to be consistently most abundant (Table 3). *Bufo americanus* (American toad), *B. fowleri* (Fowler's toad), *R. catesbeiana* (bullfrog), *R. clamitans melanota* (green frog),

Table 2.—Total minnow trap captures of *Ambystoma* salamanders in four wetland types. Unisexual hybrids are included with *Ambystoma laterale.* Numbers of wetlands of each type that were sampled are in parentheses after the wetland type. In 2000 the previously sampled wooded temporary ponds were dry due to drought so two open ponds that were in the vicinity (within 150 meters of the wooded ponds) were sampled. The wooded temporary ponds in the original study site filled in 2001, so were revisited. In addition, five new study sites with eight wooded temporary wetlands, one temporary swamp and one permanent swamp were sampled. In 2002, the original study site was sampled, and also two of the wooded temporary ponds sampled in 2001 were included. Aj = *Ambystoma jeffersonianum,* Al = *Ambystoma laterale,* Am = *Ambystoma maculatum,* At = *Ambystoma texanum,* and Ati = *Ambystoma tigrinum tigrinum.*

Year/Wetland type	Trap nights	Aj	Al	Am	At	Ati
1997						
Temporary pond (3)	1223	15	159	0	307	0
Temporary swamp (1)	180	0	0	0	0	0
Permanent pond (1)	516	0	0	0	0	0
Permanent swamp (1)	450	0	0	0	0	0
1998						
Temporary pond (3)	573	15	8	0	196	0
Temporary swamp (1)	84	0	0	0	0	0
Permanent pond (1)	84	0	0	0	0	0
Permanent swamp (1)	210	0	0	0	0	0
1999						
Temporary pond (3)	837	25	182	0	449	4
Temporary swamp (1)	124	0	0	0	0	0
Permanent pond (1)	124	0	0	0	0	0
Permanent swamp (1)	310	0	0	0	0	0
2000						
Temporary pond (2)	144	0	5	0	20	2
Temporary swamp (1)	180	1	9	0	12	0
Permanent pond (1)	216	0	0	0	0	0
Permanent swamp (1)	216	3	27	0	192	0
2001						
Temporary pond (11)	3748	42	811	11	1135	21
Temporary swamp (2)	519	3	24	0	35	0
Permanent pond (1)	172	0	0	0	0	0
Permanent swamp (2)	641	0	4	0	42	0
2002						
Temporary pond (5)	1998	30	497	0	517	39
Temporary swamp (1)	210	0	0	0	0	0
Permanent pond (1)	432	0	0	0	0	0
Permanent swamp (1)	378	0	0	0	0	0

R. sylvatica (wood frog), and *R. pipiens* (northern leopard frog) were found at intermediate abundance. The least common frogs of Merry Lea were *R. palustris* (pickerel frog) and *A. crepitans blanchardi* (Blanchard's cricket frog). In fact, Blanchard's cricket frog was heard in only one permanent swamp and only in 2001. This was a restored swamp and 2001 was the first year it held water. The swamp was then sampled with dip nets and several *A. crepitans blanchardi* individuals were collected.

DISCUSSION

Of the 22 amphibian species whose ranges include Noble County, 20 were encountered in our studies at Merry Lea. Species that were collected in this survey that are not included in Minton (2001) belong to the Ambystomatidae: *A. jeffersonianum, A. laterale, A. ma-*

Table 3.—Mean maximum call indices for anurans. The call indices are averaged for four wetland types. Two restored wetlands were added in 2001. Ba = *Bufo americanus,* Bf = *Bufo fowler,* Acb = *Acris crepitans blanchardi,* Hch = *Hyla chrysoscelis,* Hv = *H. versicolor,* Pc = *Pseudacris crucifer,* Ptt = *P. triseriata triseriata,* Rca = *Rana catesbeiana,* Rcm = *R. clamitans melonata,* Rpa = *R. palustris,* Rpi = *Rana pipiens,* and Rs = *R. sylvatica.* Number of wetlands of each type is indicated in parentheses. Call index numbers are 1 = individuals can be counted, there is space between calls; 2 = calls if individuals can be distinguished but there is some overlapping of calls; and 3 = full chorus, calls constant and overlapping.

Year/Wetland type	Ba	Bf	Acb	Hch	Hv	Pc	Ptt	Rca	Rcm	Rpa	Rpi	Rs
1998												
Temporary pond (3)	0	0	0	0	0	0	0	0	0.7	0	0	0
Temporary swamp (1)	0	0	0	2	2	3	3	0	2	0	0	2
Permanent pond (1)	1	0	0	2	2	3	3	2	2	1	3	0
Permanent swamp (2)	1	0	0	3	3	3	1	0.5	1.5	3	3	0
1999												
Temporary pond (3)	0	0	0	0	0	0	0	0	0	0	0	0
Temporary swamp (1)	0	0	0	2	2	2	2	0	0	0	0	2
Permanent pond (1)	2	2	0	2	2	2	2	1	1	1	1	0
Permanent swamp (2)	0	0.7	0	3	2.7	3	2.7	0.7	2	1	1.3	0
2000												
Temporary pond (3)	0	0	0	0	0	0	0	0	0.7	0	0	0
Temporary swamp (1)	0	0	0	2	2	3	3	0	2	0	0	2
Permanent pond (1)	1	0	0	2	2	3	0	2	2	1	3	0
Permanent swamp (2)	1	0	0	3	3	3	1	0.5	1.5	0	1	0
2001												
Temporary pond (3)	0	0	0	0	0	0.7	2	0	0	0	0	1.7
Temporary swamp (2)	0	1	0	3	1	2	2	0	1	0	1	3
Permanent pond (1)	0.5	2	0	2	2	2	3	0.5	2	1	2	0
Permanent swamp (3)	0	0.7	0.7	3	2.7	3	2.7	0.7	2	1	1.3	0

culatum, and *A. texanum*; Bufonidae: *B. americanus* and *B. fowleri*; Hylidae: *A. crepitans blanchardi*, *H. chrysoscelis*, and *H. versicolor*; and Ranidae: *R. catesbeiana* and *R. palustris*. Of these, only *A. crepitans blanchardi* and *R. palustris* are possibly rare at Merry Lea. The absence of these new county record species from Minton's list for Noble County is probably the result of a lack of study time in the area. The species common at Merry Lea—*A. texanum, B. americanus*, *H. versicolor*, *P. crucifer*, *P. triseriata triseriata*, and *R. clamitans melanota*—are common in counties surrounding Noble County. The anurans we found seemed common throughout Noble County, with the possible exceptions of *R. palustris* and *A. crepitans blanchardi* listed above. All of the Caudata collected would be found where temporary breeding ponds are surrounded by appropriate forested adult habitat. With increased development in Noble County, these two critical habitat elements are becoming more rare and unlinked.

The collection of *A. jeffersonianum* extends the species range. Brodman (2001) collected *A. jeffersonianum* in Wells County just south of Noble County, so its discovery in our study is not surprising. Several *Ambystoma* salamanders (*A. jeffersonianum*, *A. laterale*, *A. texanum*, and *A. tigrinum*) can form female triploid hybrids that reproduce via gynogenesis (Bogart & Licht 1986). The hybrid members of this complex cannot be identified, nor separated from the diploid species, in the field. Since the exact identity must be determined by analysis of the genome, we cannot be certain that all of the 134 salamanders we identified as *A. jeffersonianum* were the diploid bisexual species. We did collect male *A. jeffersonianum*, which proves that the bisexual species is present at Merry Lea. On average, only 36.2% of the *A. jeffersonianum* we collected were male, therefore there were probably many unisexual female *A. jeffersonianum/A. laterale* hybrids previously known as *Ambystoma platineum* (formed from the fusion of a diploid egg and a haploid sperm, resulting in a nuclear condition of two sets of *A. jeffersonianum* chromosomes and one set of *A. laterale* chromosomes, or JJL), or *Ambystoma tremblayi* (JLL).

We also made no genetic analysis of the unisexual *Ambystoma* hybrids that were included with *A. laterale* in Table 2. Again, we collected *A. laterale* males, so we did encounter the diploid bisexual *A. laterale*. Without the genetic analysis, we cannot definitely determine which *Ambystoma* species were involved in the hybridizations. In Adams, Wells and Jay counties of Indiana, Brodman (2001) collected salamanders which genetic analysis identified as *A. laterale* (the bisexual diploid species) and *A. jeffersonianum/A. laterale* (JLL) triploid hybrids. The range of *A. jeffersonianum/A. laterale* unisexual triploids includes Noble County (Petranka 1998), hence an identification of the hybrids we collected as *A. jeffersonianum/A. laterale* (JLL) unisexuals is plausible. The appearance of many of the hybrids we collected was intermediate between *A. laterale* and *A. texanum*. The range of *A. texanum*/A. laterale unisexuals stops abruptly at the northwest Ohio-Indiana state line and extends into southern Michigan (Petranka 1998; Kraus 1985; Bogart et al. 1985). Given that Merry Lea is about 64 km from the state line and the *A. texanum/A. laterale* unisexual range, it is entirely possible that some of the hybrids we collected are *A. texanum/A. laterale* hybrids.

Good habitat for the two species not encountered, *H. scutatum* and *N. maculosus*, was not common in our study area. *Hyla scutatum* prefers to nest on moss mats that allow the larvae to wiggle through to open water. Most of the bog habitat in our study area was degraded when the lake levels were lowered to promote agriculture, making breeding habitat for *H. scutatum* rare. Still, more systematic surveys are justified in the higher quality bog remnants. *Necturus maculosus* was not encountered in surveys of ditches on site, nor has it been captured in Cub Lake, the smallest lake in the survey area, or in permanent ponds. The mudpuppy has declined in Indiana, possibly due to increased siltation and chemical pollution (Minton 2001). Since the Learning Center is surrounded by agriculture and has experienced much siltation, mudpuppies may have been extirpated.

The high richness and abundance of amphibians we found can be attributed to physical characteristics of the study property. The landscape contains healthy temporary, semi-permanent, and permanent wetlands for amphibian breeding and adult use. The temporary wetlands protect *R. sylvatica* tadpoles and *Ambystoma* larvae from vertebrate predators that are voracious consumers of eggs and larvae. The permanent wetlands, many of which are restored, provide ample tadpole habitat for other anurans. These wetlands are still directly linked with upland habitat that is suitable for metamorphs emerging in summer and fall, and for adults. The metamorph stage can be particularly sensitive to inappropriate habitat since they may not be able to direct their movements toward suitable habitat (Rothermel 2004; but see also Marsh et al. 2004; Rothermel & Semlitsch 2002) and are more susceptible to desiccation (Spight 1968).

In a wide survey of northwest Indiana landscape variables, Brodman et al. (2003) correlated the presence of ditches and agriculture within 200 m with lower amphibian species richness and abundance. Amphibian richness and abundance were positively correlated with the number of wetlands within 400 m, wetland area, and the presence of semi-permanent hydrology. As a relatively large preserve, Merry Lea can maintain wetland complexes with temporary to permanent hydrology in places removed from agricultural development. This protection of wetlands not only buffers them from sources of chemical contamination, but also protects the essential upland habitat suitable for metamorphs and adults. Increased fragmentation of landscapes that separates larval habitat from adult habitat, and wetlands from each other, puts amphibian populations in northeastern Indiana at risk.

Long-term data are critical to ensure accurate assessment of amphibian species richness. In our study, we were not always able to detect the presence of less common species, such as *B. fowleri*. Because the property was surveyed for several years, we are confident that the Fowler's toad population is stable. Long-term data overlap years when environmental conditions such as drought or flood prevent breeding by particular amphibians, or when the landscape changes through fragmentation or restoration. In the last year of this survey, we were able to document *A. crepitans blanchardi* breeding in a newly-restored wetland. This sort of monitoring is being done accurately by trained citizens who survey anuran calls and salamanders locally (Nelson & Graves 2004; Lepage et al. 1997). These data have great potential to enhance our ability to appropriately identify and protect amphibian populations in the midwestern USA.

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BATS OF CAMP ATTERBURY IN SOUTH-CENTRAL INDIANA

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ABSTRACT. Eight species of bats were found at Camp Atterbury, a military training facility in Bartholomew, Brown, and Johnson counties, Indiana. Listed in approximate order of decreasing abundance they are the big brown bat (*Eptesicus fuscus*), red bat (*Lasiurus borealis*), eastern pipistrelle (*Pipistrellus subflavus*), northern myotis (*Myotis septentrionalis*), Indiana myotis (*Myotis sodalis*), little brown myotis (*Myotis lucifugus*), evening bat (*Nycticeius humeralis*), and hoary bat (*Lasiurus cinereus*). The first seven of these produce young on the facility.

Keywords: Bats, Indiana, Chiroptera, roosts

Camp Atterbury Joint Maneuver Training Center is a military training facility in Bartholomew, Brown, and Johnson counties, Indiana. In August 1997, 3D/International, Inc. conducted a mist net survey of bats at Camp Atterbury, capturing 13 endangered Indiana myotis, including reproductive females. This prompted the Military Department of Indiana (MDI), at the request of USFWS, to initiate radio-telemetry studies of the Indiana myotis at Camp Atterbury. The goal was to identify roost trees and their locations, and to characterize the habitat surrounding the roost trees in an effort to better understand summer habitat use by the species. Results from the study were to allow integration of management for the Indiana myotis into the facility's Natural Resources Management Plan.

During the summer of 1998, MW Consulting (1999) conducted the initial radio-telemetry study on the installation. A mist net survey of 18 sites resulted in capture of 23 Indiana myotis and 5 state-endangered evening bats. During this study, bats were found night-roosting under bridges. Therefore, MW Consulting occasionally monitored under bridges on or near the post and found a total of 82 night-roosting Indiana myotis (Kiser et al. 2002). Seven Indiana myotis captured in mist nets or under bridges were fitted with radio-transmitters and tracked to roost trees.

In 2002, Indiana State University was contracted by MDI to perform a maternity roost study on Indiana myotis and evening bats. The goals of the study were to 1) gather information about the overall bat community on Camp Atterbury, 2) determine the location and habitat of roost sites on Camp Atterbury, and 3) estimate use of roost sites through emergence counts. Roosting behavior of these two species will be described in a later paper. The objective of this paper is to summarize the results of these studies.

Description of area.—Camp Atterbury is located in south-central Indiana, approximately 56 km south of Indianapolis, and comprises 13,408 ha of mostly forested land. The post is divided into four main areas (Fig. 1): the cantonment area, impact area of the air to ground range, multi-impact training range, and battalion training area. With the exception of the impact area of the air to ground range, most of the installation was accessible except when deemed unsafe during training activities.

The landscape on Camp Atterbury varies from relatively flat terrain with gently rolling

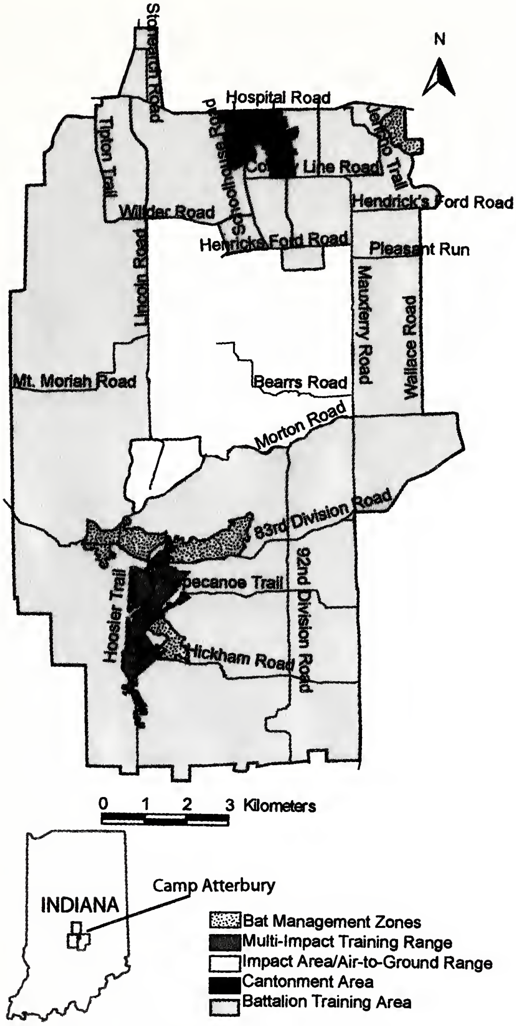

Figure 1.—Area and zones of Camp Atterbury, Indiana.

hills in the north to steep hills and narrow ravines in the south. Camp Atterbury lies at the intersection of three primary natural regions: 1) Central Till Plain Natural Region (Tipton Till Plain Section)—extensive beech/maple/oak forest, with poorly-drained flatwoods communities; 2) Highland Rim Natural Region (Brown County Hills Section)—deeply dissected uplands with well-drained soils. Natural communities are oak-hickory forest in uplands and beech, red oak, sugar maple, and white ash in bottomlands; 3) Bluegrass Natural Region (Scottsburg Lowland Section)—wide alluvial and lacustrine plains bordering major streams. Predominant natural communities here are floodplain forests and swamps (Homoya et al. 1985).

On Camp Atterbury today, the Central Till Plain Natural Region is dominated by rough-leaf dogwood, black cherry and ash. The Highland Rim Natural Region is dominated by flowering dogwood, sugar maple, red maple, sassafras and American beech. The Bluegrass Natural Region is dominated by green ash, eastern redcedar and tulip tree. Oldfield habitats are mixed with forestland associations which vary from pioneer hardwoods through mature woods, with age and stand composition often a product of past uses, which include farming and grazing. About 1600 ha of forest are in natural areas and old-growth. Forests on Camp Atterbury are managed in a multiple use context which includes commercial harvest, wildlife habitat, watershed protection, recreation, and aesthetics, in addition to supporting the primary mission of the facility as a training site.

Surface water on the installation is in the form of streams, ponds, and beaver impoundments. Several primary streams flow from west to east across the installation and drain into the Driftwood River. As part of a plan to improve Indiana myotis habitat on the southern part of the installation, bat management zones have been set aside and ponds created in three areas near the multi-impact training range (Fig. 1). In the late summer the only natural surface water in this area is from small pools along intermittent streams of narrow drainages.

METHODS

Bat survey.—Fifty-five sites were netted in summers of 1997 (4–14 August), 1998 (9 July–9 August), and 2002 (5 June–15 August): 22 sites were netted in 1997; 19 sites were netted in 1998, including 11 of the sites netted in 1997; and 17 sites were netted in 2002 (Fig. 2), generally at or near sites netted in previous years. In 1997, two nets were run for two nights at each site, for a total of 88 net-nights of effort. In 1998, two sites were netted for three nights with two nets (six net-nights each), seven sites were netted two nights (28 net-nights), and 10 sites were netted for one night (20 net-nights), for a total of 60 net-nights. In 2002, 15 sites were netted twice and two sites were netted once, for a total of 64 net-nights. Net sites were distrib-

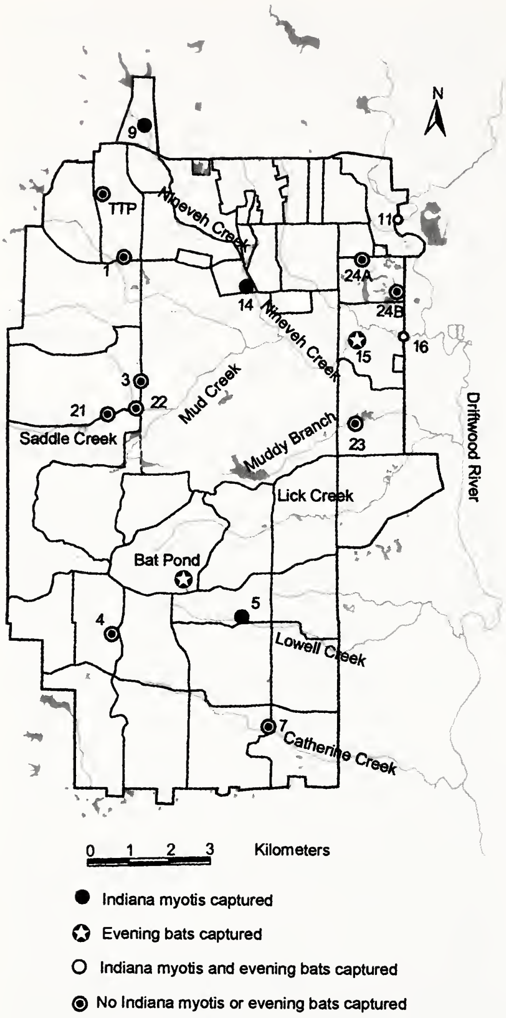

Figure 2.—Mist net sites at Camp Atterbury, Indiana.

uted across the facility (Fig. 2). In 1997, all net sites were over streams. In 1998, 11 were over streams and 7 were over upland corridors. In 2002, most sites (n = 12) were over streams; but two were placed over ponds and three over upland corridors. Chi square analysis was used to compare the number of bats caught by species across the three years of sampling and the number of bats caught per net-night, by species, across years.

All sites were netted with 2 or 3 tier 9 m × 3 m mist nets suspended by a pole and pulley system. Nets were set so that the bottom was near the ground or water and the top extended to the canopy if possible, so as to block off as much of the corridor as possible. The two nets comprising each site were set ~30 m apart. Nets were open from dusk until 0200 h. Bats were banded; and species, band number, weight, right forearm measurement, gender, age, reproductive condition, time of capture, and capture location were recorded for each bat captured. In 1998, reproductive female and juvenile Indiana myotis at least 6 g were radio-tagged and tracked to diurnal roosts; and in 2002 Indiana myotis and evening bats were tagged and tracked. Radio-tracking was accomplished using 0.47 g transmitters (frequency 150.0–151.9 kHz) from Holohil Systems, Ltd. (Carp, Ontario, Canada). Transmitters were affixed with colostomy glue after hair in the mid-dorsal portion of the bat's body was removed with surgical scissors. TRX-2000 receivers (Wildlife Materials, Inc., Carbondale, Illinois) were used to track the bats.

In 1998 and 2002, emergence counts were completed at diurnal roosts of the Indiana myotis and evening bat from approximately 20 minutes before sunset until 10 minutes after last emergence. These occurred for one to several days, as long as transmitters were active. Additional emergence counts were conducted late in the season at roosts that had contained significant numbers of Indiana myotis earlier in the summer. Night vision scopes were used during some counts in 2002. Inability to access an area due to weather, army training exercises, and limited manpower sometimes prevented emergence counts.

RESULTS

Eight of 12 species of bats recently occurring in Indiana were caught at Camp Atterbury, all in each of the three years of study (Table 1). The four most common species were the big brown bat (n = 139), red bat (n = 129), eastern pipistrelle (n = 116), and northern myotis (n = 100; Table 1). Evidence of reproduction (pregnant, lactating, or post-lactating females, or juveniles) was found for all eight species in all three years. Two endangered species, the Indiana myotis (federally listed) and the evening bat (state listed), were both moderately common (n = 43 and n = 24, respectively). The two least commonly caught species over the three years were the little brown myotis (n = 21) and hoary bat (n = 16).

In 1997, 208 bats were captured in 88 net-

Table 1.—Comparison of capture results for mist netting from 1997, 1998 and 2002 at Camp Atterbury, Indiana.

	1997 (88 net-nights)		1998 (60 net-nights)		2002 (64 net-nights)		Totals (212 net-nights)	
Species	# captured	#/net-night	# captured	#/net-night	# captured	#/net-night	# captured	#/net-night
Eptesicus fuscus (Big brown bat)	66	0.75	40	0.67	33	0.52	139	0.66
Lasiurus borealis (Red bat)	34	0.39	31	0.52	64	1.00	129	0.61
Pipistrellus subflavus (Eastern pipistrelle)	41	0.47	44	0.73	31	0.48	116	0.55
Myotis septentrionalis (Northern myotis)	31	0.35	33	0.55	36	0.56	100	0.47
Myotis sodalis (Indiana myotis)	13	0.15	23	0.38	7	0.11	43	0.20
Nycticeius humeralis (Evening bat)	11	0.12	5	0.08	8	0.13	24	0.11
Myotis lucifugus (Little brown myotis)	6	0.07	11	0.18	4	0.06	21	0.10
Lasiurus cinereus (Hoary bat)	6	0.07	9	0.15	1	0.02	16	0.08
Overall	208	2.36	196	3.27	184	2.88	588	2.77

nights for a rate of 2.36 bats/net-night (Table 1), and the most common bat taken was the big brown bat ($n = 66$), followed by the eastern pipistrelle, red bat, and the northern myotis. In 1998, 196 bats were captured in 60 net-nights (3.27 bats/net-night) and the most common species was the eastern pipistrelle ($n = 44$) followed by the big brown bat, northern myotis, and red bat. In 2002, 184 bats were captured in 64 net-nights at a rate of 2.88 bats/net-night (Table 1); and the red bat was the most common bat taken, followed by the northern myotis, big brown bat, and eastern pipistrelle. The number of bats captured per net-night was greatest in 1998, followed by 2002, and was least in 1997. This difference was significant ($\chi^2 = 10.2$, 2 *df*, $P = 0.01$) but the reason for the difference is not known.

The big brown bat is the most abundant bat in Indiana during summer (Mumford & Whitaker 1982; Whitaker et al. 2002), and was the most abundant species at Camp Atterbury (Table 1). The variation in catch among years ($n = 66$, 40, and 33 in 1997, 1998, and 2002, respectively) was not significant ($\chi^2 = 3.1$, 2 *df*, $P = 0.05$). In 2002, when netting was conducted across the summer season, two pregnant big brown bats were captured on 12 June, one lactating female on 7 July, and eight post-lactating females were captured 25 July–26 August. Twelve juveniles were captured 12 July–6 August.

Red bats were captured at a rate of 1.00 bats per net-night in 2002 (Table 1) as compared to 0.52 in 1998 and 0.39 in 1997, a difference that was significant ($\chi^2 = 24.1$, 2 *df*, $P = 0.01$). This may indicate that red bats were increasing over time. In 2002, a pregnant red bat was captured 5 June, a lactating female was captured 25 July, and 25 juveniles were captured 21 July–15 August.

The eastern pipistrelle was the third most commonly caught species. Eastern pipistrelles sometimes roost in buildings, but most roost in clusters of leaves in woods (Veilleux et al. 2003). They hibernate in caves and mines, usually within about 95 km of where they spend the summer. The catch of eastern pipistrelles was greatest in 1998, but the catch did not vary greatly among years ($\chi^2 = 5.32$, 2 *df*, $P < 0.05$). In 2002, when netting was completed across the summer season, a pregnant female was captured on 7 June, three post-lactating individuals were taken 21 July–5 August, and 21 juveniles were captured 21 July–15 August.

The northern myotis was the fourth most abundant bat at Camp Atterbury. It roosts in a variety of situations, in holes or cracks or under sloughing bark of trees. Capture success for the northern myotis was significantly lower in 1997 ($\chi^2 = 4.55$, 2 *df*, $P < 0.05$). In 2002, a pregnant female was captured 6 June, a lactating female was captured 7 July, and 15 post-lactating females were captured 22 July–12 August. Nine juveniles were captured 12 July–7 August.

The Indiana myotis is federally endangered, but is moderately common in Indiana and regularly occurs at Camp Atterbury. Areas north, northeast, and east of the Impact Area appear important for the species, especially along

Nineveh Creek (Figs. 2, 3). Indiana myotis were captured at a significantly greater rate of 0.38 bats per net-night in 1998 as compared to 0.11 and 0.15 in 2002 and 1997, respectively ($\chi^2 = 11.2$, 2 *df*, $P = 0.01$). However, half the netting effort in 1998 was completed when juvenile Indiana myotis were initiating flight and are more easily caught; 17 of 21 Indiana myotis, 9 of them juvenile, were captured during this time. In addition, net sites in 1998 were concentrated in locations that produced Indiana myotis in 1997. Twenty roost trees used by this species were found in 1998, and 26 roost trees were found in 2002 (Fig. 3). In 2002, the first pregnant, lactating, and juvenile Indiana myotis were captured on 8 June, 8 July, and 24 July, respectively, indicating parturition was between 8 June–8 July and that juvenile bats became volant between 8–24 July. Three juveniles were captured 24 July–2 August.

The evening bat is state endangered. Moderate numbers were found at Camp Atterbury, and they used 11 roost trees. Capture success was similar in all three years (Table 1), ranging from 0.08 to 0.13 bats/net-night. A pregnant evening bat was captured on 12 June 2002, two lactating individuals were taken on 7–8 July, and five juveniles were captured 21–30 July. Captures of evening bats were common along the Driftwood River east of the Impact area. This appeared to be a prime area for the species, as evening bats often reside along tributaries of major rivers.

In 1997, 11 evening bats were caught at four sites along the northeast edge of the facility. In 2002, ten evening bats (two juveniles, two males and three females) were captured at the Bat Pond net site on 83rd Division Road near the MPTR on 21 and 30 July, respectively. This area is approximately 7 km west of roosting areas along the Driftwood River (Fig. 2).

The little brown myotis is a common bat in Indiana, but few individuals were caught at Camp Atterbury. Post-lactating females were captured during all three survey years (beginning on 14 July in 1998 and continuing through mid-August in all three years) and juveniles were captured in 1997.

Hoary bats are uncommon (or at least are uncommonly netted) in Indiana. Thus it is noteworthy that, in the three years of survey, 16 individuals were caught, including nine in 1998. A lactating female was caught on 10 July 1998, post-lactating females were caught in August in all three years, and a juvenile was caught in August 1997. Hoary bats were captured at a rate of 0.15 bats/net-night in 1998, as compared to 0.07 in 1997 and 0.02 in 2002. Numbers were too small for statistical testing.

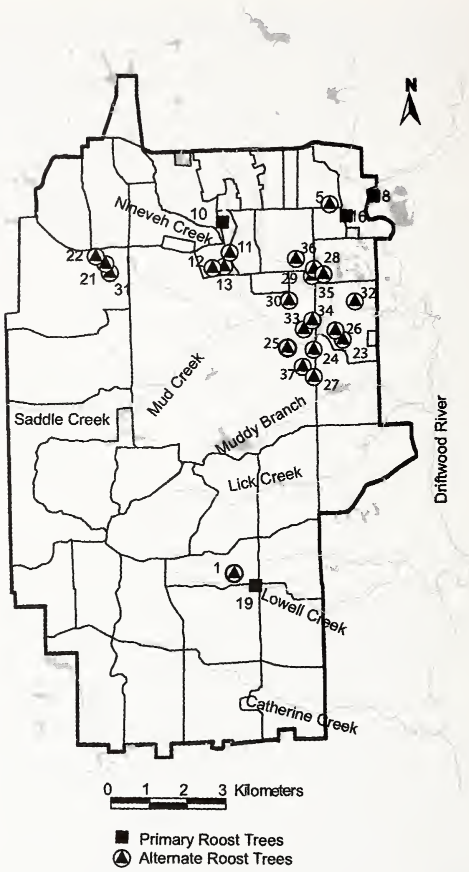

Figure 3.—Indiana myotis roost trees at Camp Atterbury, Indiana.

DISCUSSION

Eight of 12 species of bats common to Indiana were caught at Camp Atterbury. Of the four remaining species found in Indiana, three would not be expected there. The gray myotis (*Myotis grisescens*) occurs only along the Ohio River, primarily near Sellersburg in Clark County. Rafinesque's bat (*Corynorhinus rafinesquii*) is a rare visitor from Kentucky, and the southeastern myotis probably has been extirpated from the state. The silver-haired bat undoubtedly occurs on Camp Atterbury as a

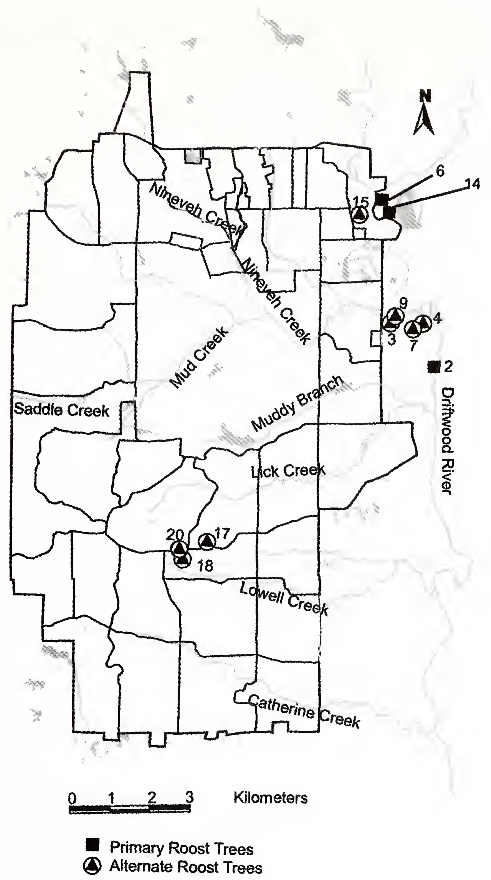

Figure 4.—Evening bat roost trees at Camp Atterbury, Indiana.

migrant through the region in spring and autumn, earlier and later, respectively, than netting was completed for this study. Evidence of reproduction was obtained for all eight species during each of the three years of sampling, indicating that this is an important area for all of these species.

It appears that at least three colonies of Indiana myotis and at least two colonies of evening bats exist on or near Camp Atterbury (Figs. 3, 4). Both species used multiple primary roost trees. Using the total of the highest counts from roost trees, it was estimated that the minimum number of Indiana myotis on or near Camp Atterbury in 2002 was 222 (post-volancy), and the minimum number of evening bats was 206, although the emergence count from one tree (n = 91) was during the pre-volant period. Evening bats usually give birth to two offspring per gravid female. Therefore, had the count been conducted after young were volant, the number of bats emerging from the roost could have been up to three times larger.

Clem (1993) found that the mean foraging distance of pregnant, lactating, and post-lactating female evening bats from a colony in Clay County was 2.25–2.50 km. Assuming juveniles captured at the Bat Pond site displayed similar foraging behavior, it is possible that the three alternate roost trees (numbers 17, 18, and 20) near the Bat Pond capture site provide further evidence of a second colony. All evening bat colonies found in Indiana before 1995 were in buildings, whereas those located since 1995 have been in trees, generally in cavities. All roosts for evening bats found on Camp Atterbury were in trees.

Primary roost trees of Indiana myotis and evening bats were found in the same area along the Driftwood River (Figs. 3, 4). Indiana myotis normally roost under sloughing bark on trees, whereas evening bats are normally in holes and cracks in trees. Indiana myotis normally feed on dipterans, homopterans, small beetles, and moths (Brack & Laval 1985; Kurta & Whitaker 1998; Murray & Kurta 2002), whereas evening bats feed heavily on beetles, hemipterans, and moths (Brack 1985; Whitaker & Clem 1992). Thus, these two species use different types of roosts and feed on different types of insects, reducing competitive overlap.

Two "house bats," the big brown bat and little brown myotis, were captured; both are common in Indiana. However, the big brown bat was the species most often caught and the little brown myotis was the species least often caught. There are few houses or other structures on or near the post suitable for roosting. The difference in the catch of the two species may be related to roosting ecology. The big brown bat forms larger numbers of smaller colonies, whereas the little brown bat forms relatively fewer colonies that often are much larger (Whitaker & Gummer 1988), increasing the probability that colonies of big brown bats were located near the post. Also, the big brown bat will fly longer distances to forage (Everette et al. 2001).

The big brown bat is probably the most frequent competitor with the evening bat. They consume similar foods (including many hard insects, beetles, and hemipterans) and both commonly forage over crop fields (Whitaker 1995; Whitaker & Clem 1992; Duchamp et al. 2004). They may also compete for roost sites. Until about 1995, all evening bat roosts found in Indiana were in buildings, although colonies located since that time have been in tree cavities (Whitaker & Gummer 2003). In contrast, the big brown bat has and continues to roost in buildings.

The northern myotis and little brown myotis are closely related taxonomically and ecologically to the Indiana myotis. Foods eaten by both species overlap heavily with foods of the Indiana myotis (Belwood 1979; Brack & Whitaker 2001). Although the little brown myotis typically roosts in buildings, the northern myotis typically roosts in trees. Like the Indiana myotis, the northern myotis sometimes roosts behind sloughing bark, but also frequents cracks and cavities in trees. However, the northern myotis is much less dependent on solar warming than is the Indiana myotis (Lacki & Schwierjohann 2001). The northern myotis was captured more frequently in the Hoosier National Forest (Brack et al. 2004) and at the Naval Surface Warfare Center at Crane (Brack & Whitaker 2004), both in southern Indiana, than they were at Camp Atterbury. In contrast, the relative capture rate of the Indiana myotis at Camp Atterbury was greater than at either of those locations. While this relationship may be coincidental, this may reflect greater amounts of woodland at Crane and at Hoosier National Forest. Another possibility is that there may be a competitive association between these species of *Myotis*.

Camp Atterbury presents a relatively contiguous landscape in which bats are doing well, even in the context of the military's training mission. Red bats may even be increasing. Red bats are solitary bats that roost in trees, and the increase could be related to changes in the forests at Camp Atterbury. The abundance and proximity of woodlands and caves probably accounts for the abundance of eastern pipistrelles. The abundance of forest accounts for the abundance of the northern myotis. Current and future training practices will affect the environment. An Endangered Species Management Plan (ESMP) was completed for the Indiana myotis in 2001 which will guide research and management activities on Camp Atterbury while maintaining the facility's military training mission. The ESMP reflects the dedication of Camp Atterbury to the long-term conservation of the Indiana myotis, which should benefit other species of bats as well. Continued monitoring of all species of the bat community should continue to define relations between species and determine whether changes in populations occur as land use and management practices change. The presence of evening bats on and near Camp Atterbury presents an opportunity to collect valuable information on an uncommon, state-listed species. There are many other military bases around the country, and many of them contain excellent habitat for bats and other species, thus should be excellent places to learn more about our environment.

ACKNOWLEDGMENTS

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JACKSON DAN WEBSTER: A LIFE IN THE FIELD

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Editor's Note. This is the first in a series of biographical articles honoring notable living members of the Indiana Academy of Science. These scientists have all served the Academy with distinction and made valuable contributions in their respective fields of scientific inquiry. We have chosen Dr. Jackson Dan Webster, Professor Emeritus in the Biology Department at Hanover College, as the subject of this first installment in the series.

It is a particular pleasure for me to have been asked by Jim Berry to write the first article in this biographical series. When J. Dan Webster retired in 1984 as a member of the Biology Department at Hanover College, I was hired into the position that he had occupied for 35 years (Fig. 1). Thus, I am Dan's successor; and I proudly occupy the J. Dan Webster Laboratory of Biodiversity in the new Science Center at Hanover. By coincidence, I actually attended his retirement reception on campus; it happened to be on the same day as my interview. I heard many J. Dan stories at that reception, including tales of his legendary energy in the field, where he would quickly outpace his much younger students. After several field trips with Dan when I arrived at Hanover, I believed those stories. Today, over twenty years after retirement he is still the same energetic biologist, perhaps slowed down a bit, but not much. One often sees Dan, in his trademark long-brimmed field cap, briskly walking across campus. Dan regularly comes into the Science Center where he continues to work on ornithological research projects.

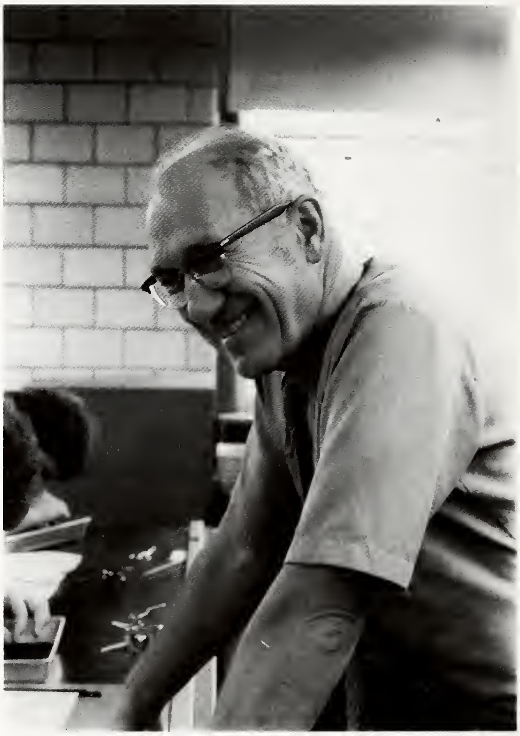

Figure 1.—Jackson Dan Webster in the zoology lab in Goodrich Hall in the 1980's. Dan's teaching and research career at Hanover College spanned 35 years.

GROWING UP IN THE NORTHWEST AND ALASKA

Jackson Dan Webster was born in Tacoma, Washington on 26 February 1919, but spent most of his boyhood in Sitka, Alaska, an ideal location to develop an interest in the natural world. His interests were promoted by his father and mother, Jackson L. Webster and Laura Kibbe Webster. Dan's father was a Presbyterian minister. He was also a keen naturalist, hunter, and fisherman, an obvious influence on young Dan growing up in the magnificent forests of southeastern Alaska. His mother was a teacher and accomplished musician who greatly enjoyed wildlife as well, especially birds. At an early age, Dan knew that he wanted to be a scientist.

After graduation from Sitka Territorial High School in 1935, Dan went to Whitworth College in Spokane, Washington. A memorable mentor at Whitworth was Leslie Hedricks, *the* biology professor (Whitworth had only about 200 students at the time). Dan briefly considered a medical career, but was dissuaded from that path by observing another student and friend who was very bright and very adept at dissection and laboratory procedures. Dan was not as adroit in the lab; he decided that if manual dexterity was an important criterion to be a good physician, maybe he should pass on medical school and pursue his zoological interests, and that is what he did (his nimble friend went to Harvard Medical School).

GRADUATE STUDIES

Dan pursued graduate study at Cornell University in Ithaca, New York, beginning in 1939. He studied ornithology under A.A. Allen, a well known ornithologist and field biologist, and one of the few ornithologists to do field research on the Ivory-billed Woodpecker. Allen's classic 1935 photo of an Ivory-billed in Louisiana has been widely seen in recent months due to the rediscovery of the Ivory-billed in Arkansas. Dan graduated in 1941 with a Master of Science degree. His thesis research took him back to Sitka, Alaska, where he could live at home and study the life history of the Black Oyster-catcher (*Haematopus bachmani*). This species of oyster-catcher is found along the western coast of North America and feeds on marine invertebrates, mainly mollusks. Little was known about its breeding biology when Dan began his studies (Webster 1941). Dan's study sites were surf-beaten, rocky islands located 1 to 12 miles off the coast; Dan had no motorized transport and *rowed* out to the islands with his supplies where he would often stay for several days. On one trip his rowboat swamped while he was ashore on a small rocky island, and he lost his spotting scope and supplies. Dan then rowed the 12 miles home, arriving around dusk, about 9 pm in early July in those latitudes. (Now that's field work!)

Upon completion of his master's degree, Dan went to Rice Institute in 1941, now Rice University, in Houston, Texas, for a Ph.D. in the field of parasitology under Asa C. Chandler, an internationally-known parasitologist and author of a classic textbook on parasitology. Dan had developed a strong interest in parasitology and, at the beginning of World War II, it was becoming apparent that there was a need for more parasitologists to deal with the growing problem of parasite-borne diseases encountered by American soldiers overseas. The war interrupted his Ph.D. program. He was at Rice for a year and a half, then drafted, served three and a half years in the army (1942–1946), and finally received his Ph.D. in 1947.

Dan's Ph.D. dissertation consisted of two projects: one was a systematic survey of the parasites of Bobwhite Quail (*Colinus virginianus*) which resulted in the description of two new species of tapeworms (Webster 1948). He also performed experimental work attempting to determine the life history of a tapeworm, *Mesocestoides latus*, common to opossum and raccoons. His study was inconclusive (Webster 1949); it would not be until the 1980's that it was finally discovered that an underground mite was the first intermediate host and a lizard was the primary second intermediate host.

PARASITES, WAR, AND MARRIAGE

The army made good use of Dan's zoological expertise. After military training, he was put in charge of a medical lab at an Army hospital in Ogden, Utah (Fig. 2). The hospital was located at a POW camp where Italian, German, and Russian POW's were shipped from Europe. Due to a shortage of regular army personnel, Dan trained POW's as lab technicians. In addition to hospital related lab testing, he did a major survey of local mosquito populations including *Anopheles occidentalis*, a facile carrier of malaria. What was the concern about malaria in Utah? The POW's, especially the Italian soldiers, carried malaria; it was endemic in parts of Italy and North Africa. It was feared that local mosquitoes could pick up the parasite from POW's and infect the residents of the area. Fortunately, that did not happen. Dan rose from private to first lieutenant during his service and returned to Rice.

It was during the war years that Dan met and married Juanita Ross (Fig. 3). Nita is well-known to members of the Indiana Academy of Science, and she has attended many IAS meetings. In 2004 they celebrated their 60th wedding anniversary. Dan and Nita met at Rice; Nita was a biology major and Dan was her teaching assistant in an undergraduate biology lab, where, Dan notes, she was the

Figure 2.—Dan in army uniform during his military training in Springfield, Missouri in 1943.

Figure 3.—Dan and Nita Webster, portrait taken in 2001. The Webster's celebrated their 60th wedding anniversary in 2004.

best student in the class. They married in 1944 while Dan was in the service. Nita is a biologist in her own right and taught biology labs at Hanover College for three years in the 1960's; she is well known for her gardening and botanical expertise, especially with the wildflowers of southeastern Indiana.

Dan and Nita have three children, all of whom followed careers in education. His two sons are both professors of biology. Jackson Webster received his Ph.D. from the University of Georgia and today is a systems ecologist in the Biology Department at Virginia Tech in Blacksburg, Virginia. Marcus Webster received his Ph.D. from Washington State and is an animal physiologist at St. John's University in St. Cloud, Minnesota. Their daughter, Majorie Webster Underwood, met her future husband, a British citizen, while on a college trip to England to study Shakespeare. They have lived in Great Britain for many years and both have pursued careers in education; Majorie was an elementary school teacher and eventually became a Head Teacher (our equivalent is a principal); she is now retired.

A LONG CAREER IN TEACHING AND RESEARCH

Dan's first professional appointment was as an Assistant Professor of Biology, then Associate Professor, at Jamestown College in North Dakota (1947–49). Jamestown is a small liberal arts college and Dan was in a two-person department. When Dan applied for college positions he had sent out a number of applications to small colleges. While at Jamestown, he was contacted by Albert J. Parker, Jr., President of Hanover College at that time. The Biology Department at Hanover needed a zoologist and Parker had found Dan's old application—did Dan want the job? Such a hiring is hard to imagine today, but at the end of the war, colleges in the United States were being flooded with returning military personnel; qualified academics were in

Figure 4.—Much of Dan's field research took place in Alaska. This photograph from 1972 shows Dan on the Alcan Highway, enroute to a study site.

short supply. The salary at Hanover was better, the campus was beautiful, and the Webster family came to Hanover College for what was to be a long and productive 35 year career (1949–1984).

Teaching is the primary mission at Hanover College, but Dan kept up an active research program over his career. If asked to describe himself as a biologist, Dan says he is a zoologist with special interests in ornithology and parasitology. He also considers himself to be a field biologist, not an experimentalist (he notes that lab experimentation is not his forte). Dan's work has largely been pure research, not applied, although some of his papers have important conservation implications.

Outside of Indiana, the geographic focus of Dan's field work was in Alaska (field seasons in 1940, 1946, 1972, 1975, 1977, 1981, 1983, 1985, and 1986) and in Mexico (field seasons in 1950, 1952, 1954, 1955, 1957, 1959, 1964, 1965, and 1968). As can be seen, he worked in Mexico in the 1950s and 1960s, but returned to Alaska in the 1970s and 1980s (Figs. 4, 5). Although it was cheaper and more logistically convenient to work in Mexico, growing concerns about the safety of working in isolated parts of Mexico prompted the switch to Alaska. Each of these years he was camping in the field from three weeks to five months. Dan's field research emphasized birds, but included mammals, parasitic worms, and general ecology (e.g., Webster 1963, 1983). In addition to his research in Alaska and Mexico, Dan has undertaken diverse studies in Indiana as well. He is well known as an authority on the birds of Indiana and made important contributions to the ornithology of the state (e.g., Webster 1966, 1974, 1998).

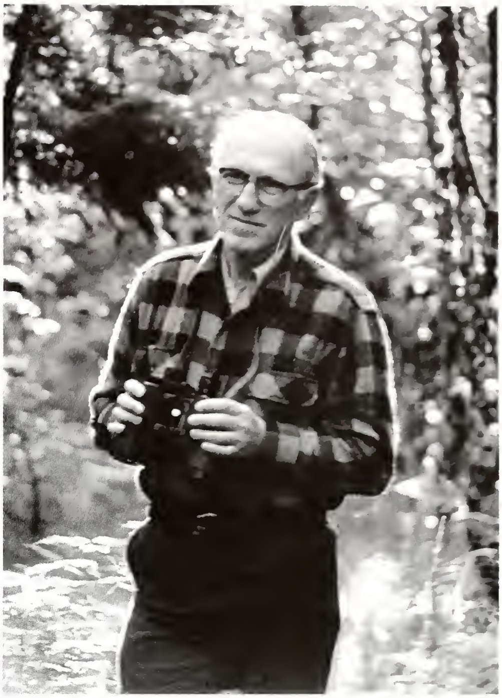

Figure 5.—Dan in the field, binoculars ready, in Alaska in 1975. Ornithology has been the main focus of his long research career.

On most of his field expeditions, Dan was accompanied and assisted by a senior biology major. Dan remembers one student, who later went on to become a professor of zoology, particularly well. Dan and the student were camping on a large ranch in the Sierra Madre Occidental in Mexico. This was rugged, pine forest country with many cliffs, ravines, and streams. They were surveying birds, mammals, and beetles in the area, and the student left early one morning for survey work, but forgot to take a topographic map with him. When the student did not come back later in the day as planned, Dan became concerned, and with the ranch owner's help mounted a search, including five mounted *vaqueros*—nothing. Dan, of course, feared for the worst—every professor's field trip nightmare. Dan and the rancher were commiserating at lunch two days later when, 54 hours after he

Figure 6.—Dan with students in old Goodrich Hall (~1964). A number of the mammal specimens on the table are still in the Hanover collection and used in classes.

left, the student showed up at the ranch, guided by an Indian. Without the map, the student had gotten terribly lost, it had begun pouring rain, and he had made some bad directional choices which took him away from the ranch. Fortunately the student ran into a family of Indians living in a cave and, overcoming language problems with hand signs, he conveyed the idea he was lost—he spent a night in the cave with the family, and the husband guided the student back to the ranch.

With a teaching career that spanned almost 40 years at two institutions, Dan has taught many, many students over the years (Fig. 6). I have spoken with a number of his former colleagues and pupils. He was considered a no-nonsense, hands-on professor; they all remember his energy level in the field—it was hard to keep up with him. They remember that he was a clear and to-the-point lecturer, who was well organized in lecture and in lab. He paid attention to detail, noting, for example, the skill, or lack thereof, with which student dissections were done. His primary courses were general biology, ornithology, parasitology, vertebrate comparative anatomy, senior independent study, and less frequently, a course in conservation. He taught a five-week long field course called Vertebrate Field Zoology for 13 years in which students traveled to the southern Appalachians. Over the years, Dan has supervised dozens of independent study projects by senior students on a wide variety of topics.

I have heard many J. Dan stories from former students, especially with respect to field trips and rigorous labs. However, Dan notes that one commonly told classroom story is not true. Dan says he did not lock the classroom door precisely at the beginning of class so that tardy students could not enter and disrupt the lecture, but he did tell the students that if they were going to be late, he would rather they just not come at all.

Dan said he had one standard piece of advice for students: always take the courses that interest you and sign up for a major that you find interesting; use personal interest, not other criteria, as a guide. A partial listing of Hanover students who went on to professional careers in biological research and teaching (Webster 2001) and to whom Dan was an important mentor would include: Frank Fisher ('53), Professor Emeritus, Rice University; Patricia L. Walne ('54), Professor Emeritus, University of Tennessee; Robert H. Brewer, ('55), Professor Emeritus, Trinity College; Harold K. Voris ('62), Curator of Amphibians and Reptiles, Field Museum of Natural History; Gwilym S. Jones ('64), Center for Vertebrate Studies, Northeastern University, Boston; R. Eric Lombard ('64), Department of Organismal Biology and Anatomy, University of Chicago; and R. William Mannan ('74), Professor of Wildlife Ecology, University of Arizona.

This partial listing could be considerably expanded with the addition of more former students with Ph.D's in the sciences, students with medical and professional school degrees, and students with Master's degrees. Dr. Walne, who passed away in 2004, endowed the J. Dan Webster award in biology, given each year to an outstanding junior biology major. She was a generous friend of the Biology Department and Hanover College. It has been my pleasure to work in collaboration with one of these Hanover/Webster alums, Harold Voris, at the Field Museum of Natural History. Since 1990 we have worked on herpetological projects in Southeast Asia and Hanover students have been involved in these studies.

RETIREMENT AND REFLECTIONS ON THE SCHOLARLY LIFE

Dan retired from Hanover College in 1984. He has continued his research program as a Professor Emeritus and is still an avid field ornithologist, but his partial loss of hearing has made it impractical for him to continue doing ornithological field research. Instead, Dan returned to systematic studies of birds with an emphasis on skeletal morphology (e.g., Webster 1999, 2003). His son, Jackson, was a co-author on the 1999 paper. Dan notes that bird skeletons did not become a standard part of museum collections until the 1930's with the use of dermestid beetles to clean the delicate skeletons; he thinks that skeletons have been underutilized in systematic research. Dan really enjoys this classical systematic work, although he admits he gets annoyed with some aspects of current phylogenetic theory.

Dan is an ardent conservationist who wants to use good science to make good decisions about the stewardship of biodiversity and land, water, and air resources. He has worked with the Audubon Society for many years and was President of the Indiana Audubon Society in 1963. He was on the state board of trustees for The Nature Conservancy for six years and is currently on the Board of Directors of the Oak Heritage Conservancy, a recently formed local land trust devoted to protecting southeast Indiana's natural heritage.

Dan has been honored over the course of his career as a Fellow of the Indiana Academy of Sciences (1959), a Fellow of the California Academy of Sciences (1962), an elective member of the American Ornithologist's Union (1961), and as President of the Indiana Academy of Sciences (1979). He was IAS Zoology section chair in 1955 and secretary from 1970–72. Dan received the Brooks Award for conservation in 1985 from the Indiana Audubon Society. In addition, Dan has had a lifelong association with the Presbyterian church and he has been an active member of the Hanover Presbyterian Church; he was elected an elder of the church in 1961.

Dan's research record demonstrates that he would have been successful at a larger, more research-oriented institution. Why choose a small, liberal arts college with a heavy teaching load? His answer is simple; he wanted to teach undergraduates; and he thought that liberal arts colleges, like the one he attended, offered the best educational environment. I asked Dan how students had changed over his teaching career. He noted that there were fewer and fewer students with farming or outdoor backgrounds; increasingly, he thought, they seemed to have little contact with the natural world. He also noted the shift in emphasis in the biological sciences, away from organismal biology and ecology to molecular and cell biology. Natural history courses, like mammalogy or entomology, are disappearing from curricula.

Today the biological sciences have become increasingly specialized. Graduate programs produce focused authorities. Laboratory biologists often have no real knowledge of the natural history of the organisms with which they work. Field biologists do not have the taxonomic breadth of knowledge of their older colleagues. Dan belongs to a generation of biologists who were broadly trained—he is a true natural historian who brought both depth and breadth to his own research and to the many students he taught.

ACKNOWLEDGMENTS

I interviewed Dan in preparation for this article, and Dan provided me with photographs and bibliographic material. I thank him for his time and effort. I also thank the colleagues and former students with whom I spoke during the preparation of this article. Special thanks to Nita Webster. Thanks to Kim Kreuzberg, Hanover College Library, and Darrin Rubino, Biology Department, for assistance with photographs.

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Dr. Webster's scientific publications (journal articles and book chapters) total 154 as of 2005. Of these 126 were on birds, 19 on tapeworms or other animal parasites, four on general ecology, three on mammals, one on general vertebrate zoology, and one on the history of science at Hanover College. Of these, 19 were in coauthorship, 11 were published in the Proceedings of the Indiana Academy of Science, and one was a chapter in the *Natural Features of Indiana* (1966) published by the Academy. The literature cited in this article provides an idea of the diversity of research done by Dr. Webster.

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